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MONTANA OUTDOORS

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Front Cover
Opportunities for taking great photographs abound in Montana. Keith Szafranski's skill in "capturing nature with a camera" is proved by his front cover shot of a trumpeter swan and cygnet on their nest.

Inside Front Cover
Some people count seeing the elusive otter as a lifetime outdoor event. If you are not fortunate enough to spot one of these playful creatures on a wild Montana river, the two depicted in Karen Ray Brower's watercolor come very close to the "real thing."

Back Cover
The escape of the explosive rainbow trout on the back cover is appropriately titled, "Freedom Earned." The original watercolor is by Livingston artist Rich Stevenson.

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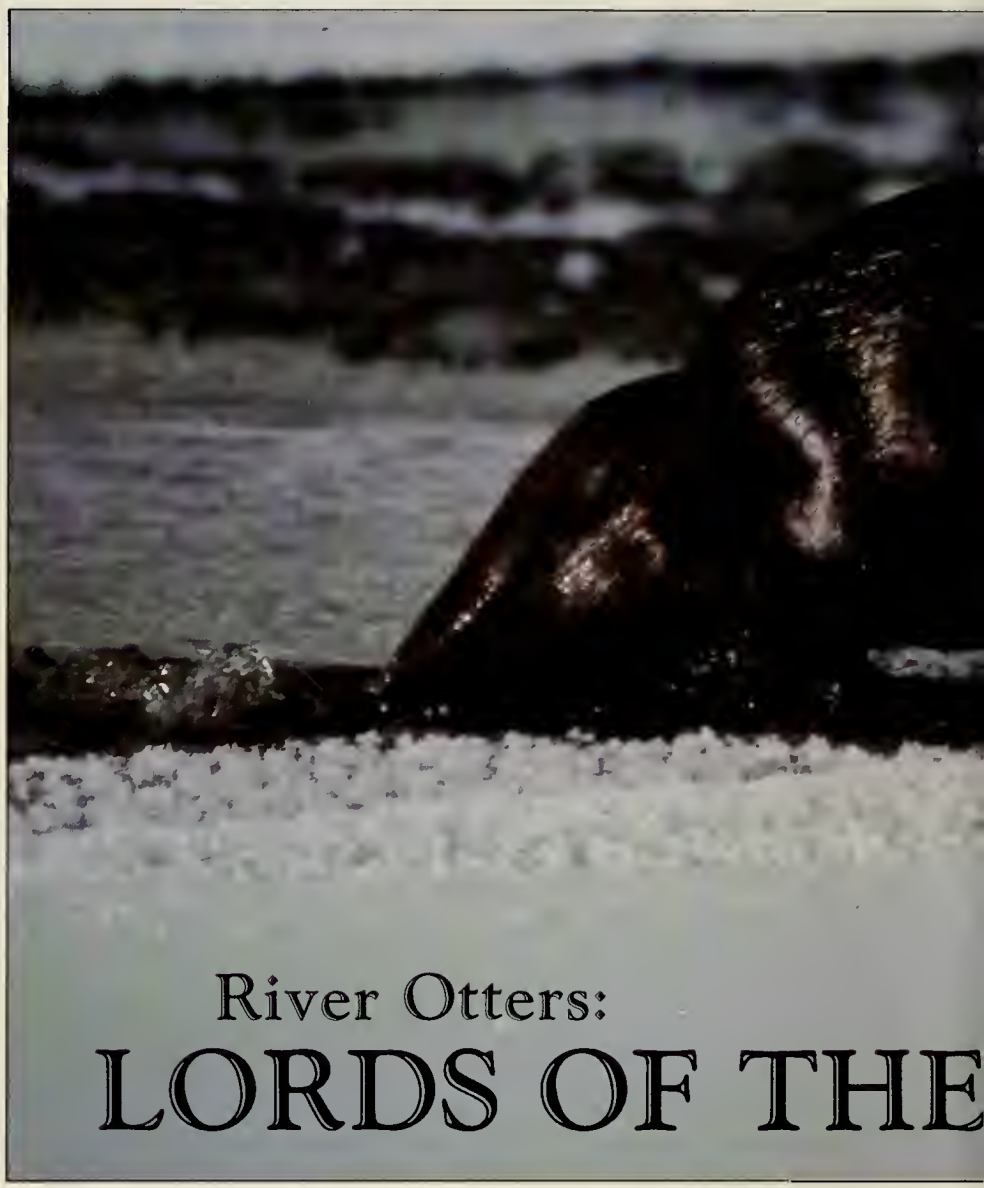


River Otters: LORDS OF THE

by Hugh Zackheim

A friend of mine is big on comparisons—sports teams, ice cream brands, even outdoor experiences. He canoed by a pair of river otters on the Missouri River this spring, and lately he's been trying to determine what that sighting is worth. In his closest resolution, he's decided that seeing the otters is comparable to landing a 19-inch brown trout on a small dry fly.

My friend's mental exercise indicates the value he places on the river otter; for him, seeing one of these elusive furbearers is a lifetime outdoor event. The other "otter viewers" I've met share this appreciation—indeed, these fortunate Montanans will readily describe years-old experiences with a detail that bespeaks an unrestrained thrill at seeing an otter on a wild Montana river.

But why do we place such a high value on an animal that few of us know much about and fewer ever see? It's a difficult and intriguing question, but maybe a look at the otter will take us closer to the answer.

*****

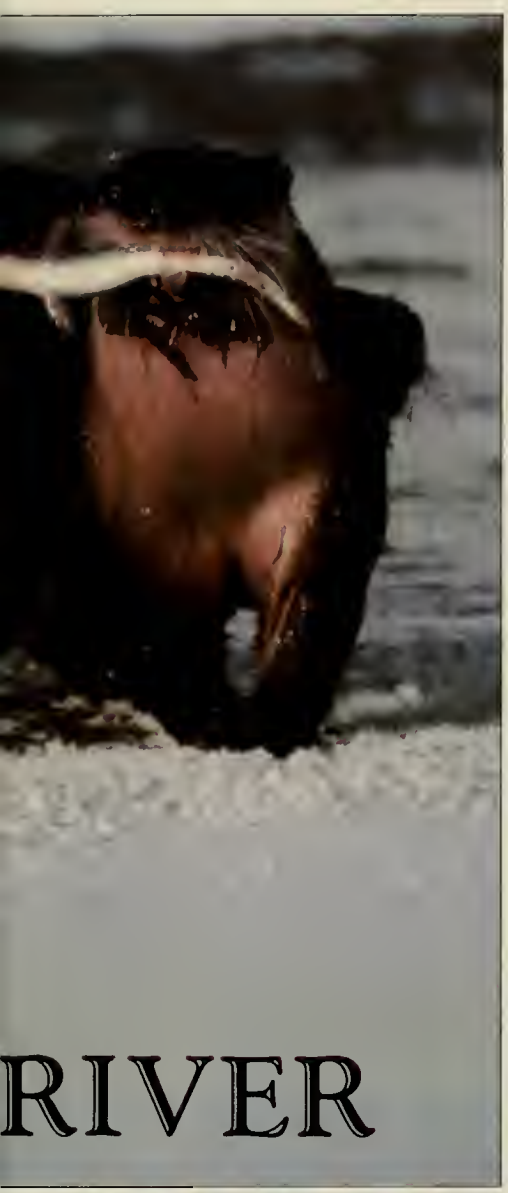
Montana's otters are members of the species *Lutra canadensis*, the North American river otter. This remarkably adaptable weasel utilizes diverse habitats, with stable populations found along the waters of interior Alaska, the estuaries and islands of the Pacific Northwest coast, the forest lakes and streams of Canada and the Northern Tier states, the mid-Atlantic tidelands, the bayous of the American Southeast, and the brawling rivers of the western mountains.

Most of us have been introduced to the otter as the "fun-loving" furbearer. Nature films show groups of otters playing tag across a frozen lake or sliding down a slick river bank, with the bouts of play occasionally interrupted by a meal of fresh fish. Researchers have found that the role of play among adult wild otters may be somewhat less than typically portrayed, but a wealth of firsthand reports clearly indicates that otters appreciate the value of "having a good time." Otter cubs display boundless energy and enthusiasm for chasing, sliding, diving, and wrestling. These games help the young otters learn about their environment and develop necessary survival skills.

Captive otters, both young and old, are almost constantly at play if given the latitude to explore any watery habitat. In "Ring of Bright Waters," Gavin Maxwell provides a classic account of the antics of his pet Asian river otters along the Scottish coast. Wisconsin naturalist Emile Liers, fondly known as the "otter man," wrote of his experiences throughout the 1950s with wild and tame North American river otters. Liers' pet otters behaved like loyal sporting dogs, and one even retrieved hunters' downed ducks from locations where no Labrador could venture. Both Maxwell and Liers were continually amazed at the otter's intelligence, curiosity, and demonstration of affection for people and one another.

It's worth noting that Maxwell and Liers gave their otters constant attention and nearly unconfined access to natural waterways, conditions impossible to duplicate by anyone with much else to do but raise otters. The rest of us—for our own good as well the otter's—will have to experience the otter as chance allows.

Observers of otters in the wild quickly come to appreciate a dominant aspect of the otter's character: his complete mastery of the environment. Otters are the supreme lords of the river, seemingly able to catch food at will, to cruise upstream



RON SHADE

RIVER

through the roughest whitewater, to intimidate other animals, to vanish at the slightest human provocation, and to do all this with an apparent appreciation of their own consummate skills.

The otter is perfectly adapted to its aquatic lifestyle. The physical components include a torpedo-shaped and well-muscled body; broad, webbed feet; short, sleek fur; and a thick, powerful tail. Otters can swim faster than trout and can remain underwater for several minutes.

Although somewhat ungainly on land, an otter can outrun a man. The otter springs forward on its front feet, then arches its supple spine and brings up the rear feet in a gait resembling a giant inchworm. On snow or ice, three leaps and a belly slide is the preferred form of locomotion. Otters will travel across many miles of wooded terrain to reach another drainage, and have been documented crossing rugged mountain passes in the Rockies and the California Sierras.

The otter's size surprises most first-time observers. Adult North American river otters generally weigh between 16 and 24 pounds, and average about four feet in length, a third of which is tail. Size and shape are the best field marks to distinguish an otter from the mink, beaver, and even muskrat that sometimes are thought to be otters by hopeful observers with a typically hurried glimpse.

The otter's well-known penchant for fish dinners has historically raised concern that otters might be outcompeting anglers for game fish. In the 1950s, several state wildlife departments conducted field studies to see if these suspicions were true. Ken Greer, now with the Department of Fish, Wildlife and Parks Research Laboratory in Bozeman, conducted a two-year study in the Thompson Lakes area of northwestern Montana. Greer's work, published in 1955, documented that otters generally take the most abundant and easiest to catch fish. Fast-swimming trout composed only a small percentage of the otter diet, while the slow, abundant species like sunfish were eaten most often. Similar results from studies across America vindicated otters as a significant game fish predator.

A 1979-81 study confirmed the "opportunistic" feeding pattern for otters living on five of southwestern Montana's outstanding trout waters—the Beaverhead, Big Hole, Gallatin, Jefferson, and Madison rivers. Regionwide, suckers were the most important item in the otter diet. These fish are abundant, lie in unobstructed areas, and swim relatively slowly—all characteristics which increase their "catchability." Sculpins, crayfish, and whitefish were the next most important prey species. Trout made up a significant portion of the otter diet only on the upper Madison River. There, trout are abundant, protective undercut banks are few, and suckers and crayfish are scarce; these factors make the trout a logical and accessible diet component. Even on the upper Madison, the otter diet very likely has no impact on trout populations because otters generally take small trout, and the upper Madison appears to have far more juvenile fish than needed to maintain the population.

Otters have generally been por-

Although fish rates high on the river otter's menu, numerous studies have shown that trout compose only a small percentage of its diet. Slower swimmers, like suckers, whitefish, and sculpins, are most commonly taken.

KEITH SZAFRANSKI

trayed as living in family groups which "play together, prey together, and stay together." Recently, however, Wayne Melquist of the University of Idaho's Cooperative Wildlife Research Unit has provided an authoritative picture of otter social behavior, both confirming and rebutting some long-held beliefs.

Melquist's pioneering research in west central Idaho represented the first successful effort to study wild otters in their natural habitat. Melquist refined techniques for live-trapping and radio-equipping otters, and during the five-year study, more than 40 river otters were monitored.

Melquist's research confirmed that otters are highly social—in sharp contrast to other members of the weasel family. Adult females with young, juvenile otters, and subadults of both sexes travel together and feed in one location in apparent harmony. The composition of these temporary groups changes frequently, and the mother-cub relationship is the only stable long-term bond. Adult male otters are "loners" except, of course, during the breeding season. Their behavior, although belying the portrait of a stable otter family group, is consistent with the solitary habits of other adult males in the weasel family.

The reproductive behavior of river otters in the Northern Rockies follows a distinct annual cycle. Adult females breed in April and, due to the characteristic weasel phenomenon of "delayed implantation," most embryonic development is postponed until the following January. At that time, the microscopic embryos "implant" in the mother's uterine wall and resume development. Two to four cubs (also called pups) are born in late March or early April, about 11 months after conception. The cubs remain in the birth den for about two months before venturing with their mother into a pond or river backwater. There they begin a formidable learning process, with swimming lessons the No. 1 item on the list.

Tracking otters via radio signals allowed Melquist to develop a picture of their movements, home range, and habitat use. Most naturalists had suspected that otters covered a lot of water, but few guessed just how far they range. Otters using the lakes and streams of west central Idaho generally range in 20 to 40 linear miles of water habitat during any one season, and some annually cover 100 miles. Adult males have the largest home ranges. Although otters in the Northern Rockies sometimes visit alpine lakes, mountain streams, or lakeshores, they spend most of their time on the larger valley rivers and associated wetlands.

Otters do not defend their home ranges, and many otters may use the same stretch of water during a year. Within its range, an otter utilizes a number of "activity centers" which provide the right combination of food and shelter. An otter or otter group might spend several days to several weeks at one activity center before moving. Frequent movements presumably permit the otters to find new food resources, thus avoiding exhaustion of fish stocks in any one place.

Otters seldom excavate their own dens and depend heavily on a fellow stream inhabitant, the beaver, for housing. Beaver dens along river banks, beaver lodges, and logjams are the otter's most commonly used resting areas. Logjams, streamside vegetation, natural rock piles, and even highway riprap are also used.

Melquist's extensive live-trapping and monitoring program allowed him to develop what may be the first reliable otter census. In his North Fork of the Payette River study area, he estimated a population of one otter per 2½ miles of major waterway. Although this figure cannot be strictly applied elsewhere, it provides a reference point for current otter populations in good, mountain valley habitat.

Before European settlement, otters were found in virtually every river system of North America. Trappers in the advance column of civilization's march took a heavy toll on otters and other furbearers to meet the tremendous European demand for American furs. Although the international fur market collapsed in the 1850s, intensive agriculture and industrialization continued to claim the clean waters and fisheries needed to sustain otter populations. This legacy of unregulated trapping and habitat destruction has eliminated river otters from significant portions of their range (particularly in the Great Plains, the central states, and the Southwest) and reduced populations elsewhere.

Information on historical otter populations in Montana is limited. The 1805 journals from the Lewis and Clark Expedition contain more than a dozen references to otters within

MICHAEL H. FRANCIS

Intelligent and playful, the river otter is perfectly adapted to its aquatic environment. It can swim faster than a trout and remain underwater for several minutes.

Montana, beginning with a sighting along the Missouri River near the present North Dakota border. Lewis reported that otters were "numerous" and "in great plenty" above the Great Falls of the Missouri where, he wrote, "the water has become sufficiently clear for them to take fish." The expedition reported many otters throughout the upper Missouri drainage, including Lewis' observation of "great quantity of beaver, otter and musk-rats" in the rivers near the present site of Twin Bridges.

Because otter pelts had a comparable value to beaver, otters were trapped heavily in Montana during the peak of the fur trapping era. Pierre DeSmet, a missionary living along the Clark Fork River in western Montana, wrote in 1841, "Like the beaver, [the otter] is incessantly pursued by the hunters, and the number of both of these animals is yearly diminishing."

More than 100 years later in 1949, state biologists did not believe otter populations in Montana were sufficient to warrant a trapping season, and a closure was instituted. In 1956, the season was reopened in western Montana with a one-otter limit, primarily to legalize sale of otters caught accidentally in beaver traps. The one-otter limit for western Montana remains in effect today.

Viable river otter populations now are found in the western part of the state, both east and west of the Continental Divide. The network of large, free-flowing rivers still provides the needed clean waters and food base, while the relatively undeveloped streamside zone meets the otter's need for security. The greatest otter densities occur on the major rivers of southwestern Montana, particularly in the Three Forks area, and in the Flathead River system upstream from Flathead Lake in northwestern Montana. Otters are mostly absent downstream from Billings on the Yellowstone River and from the head of Fort Peck Reservoir on the Missouri.

In assessing the outlook for the river otter in Montana, biologists must wrestle with a crucial question for any species: What factors limit a wildlife population? Although never a simple question, for otters the answer is exceptionally problematic. Otter food supplies, particularly "rough fish," seem excellent in most major Montana rivers. Winter habitat conditions appear to pose no great challenge for the thick-furred otter, who can readily forage throughout winter either in open water or beneath an ice cap. Overt territoriality, which plays an important population regulation role for most wild predators, has yet to be observed in the otter. Finally, hardly any predators found along Montana rivers are physically equipped to take an otter in water or on land.

Trapping is a well-documented cause of otter mortality in Montana, but current information is inadequate to assess population impacts. During the past decade, Montana trappers have reported harvesting an average of 46 otters per year statewide. Harvest distribution mirrors reported observations of live otters, with the upper Missouri and upper Flathead drainages supplying the bulk of the animals.

Because of their reproductive pattern, otters are susceptible to overharvest. Female otters first mate as 2-year-olds and, due to delayed implantation, bear their first litter at age 3. Thus, high mortality in an otter population can severely limit the number of animals reaching breeding age. Delayed implantation also has its consequences. The death of an adult female otter in late April can have population repercussions on three generations: her own, the dependent young, and the fertilized eggs she is carrying.

Managing otter harvest is not a simple proposition. Survey responses from 300 of Montana's most active "river trappers" revealed that about 75% of the otters trapped in Montana are taken in sets intended for beavers. This incidental trapping occurs because both species use common water access and exit points, and trappers naturally focus on these "runs." As a result, the number of otters trapped in Montana has historically been related to the value of beaver pelts, the key factor in determining how many traps are out on Montana waterways.

Members of the trapping fraternity are among the most concerned about the future of river otter populations in Montana. Many take specific precautions to avoid trapping otters and relatively few specifically set traps for otters each season. The mandatory pelt-tagging requirement has provided the Montana Department of Fish, Wildlife and Parks with an accurate record of harvest. To date, however, no reliable index of otter population trends has been developed.

A majority of trappers surveyed during 1981 believed otter numbers were stable or increasing in otter population centers along the upper Missouri River and its major tributaries near Three Forks and in the forks of the Flathead River north of Kalispell. On most other western Montana rivers, trappers reported a stable number or a decrease in observations of otters and their sign.

*****

This review of the status and behavior of *Lutra canadensis* brings us back to my opening question about why we care so much about the otter. On one level, the answer lies in the character of the animal as described—the river otter is intelligent, playful, a lord of the river who asks and takes nothing from man, occasionally brightens our day with a brief show, and lives in the undercurrent of our wild streams.

The rest of the otter's appeal stems from a different source. The river otter is a symbol of a quality environment; his shadowy presence reminds us that, unlike too many other waterways, Montana's rivers can sustain this large, wild, and free-ranging predator. If we remain good stewards of the river realm, we can expect to have otters sharing our waters with us well into the future.

How does a person go about seeing a wild Montana otter? Your best chance may be quietly floating a river on a July morning. During early summer, mother and cubs spend considerable time foraging and playing in river backwaters and side channels.

Unfortunately, even under ideal conditions, the odds against seeing otters are very high. Perhaps the best advice was given by Marie N. Stephenson, who completed the first comprehensive otter population study in England in the 1950s. As Stephenson noted in classic British style, "By far the best way to see otters is to take up fishing and not deliberately to watch for them at all." ■

TERRY KNUPP

Lone Pine State Park

SCENERY AND SOLITUDE CLOSE TO TOWN

by Terry Knupp

GRETCHEN OLHEISER

Ten minutes by car from Kalispell, two miles as the flicker flies, there is a hilltop in public ownership where one can stand and see the sharp peaks of Glacier National Park; the wild sweep of the Mission, Swan, and Whitefish ranges; much of the broad Flathead Valley; most of Kalispell; and a good bit of Flathead Lake.

Close to town, yet wild and undeveloped, the Lone Pine lookout has been a popular hiking, picnicking, and horseback riding area since the turn of the century. Over the last 50 years, various individuals, private organizations, and government groups have discussed the possibility of the area becoming a public park. Finally last summer, with the opening of a new visitor center and lookout trail, the dream came true.

In the 1930s, Ernest and Hazel White, Flathead Valley sheep ranchers and long-time owners of Lone Pine Hill, gave the Boy Scouts of America five acres where the visitor center now stands. In 1941, the Whites donated an adjacent 162 acres to the state of Montana. They intended that the property be "preserved for recreational purposes for the public to enjoy; and for educational purposes, that the public may more fully appreciate the benefits of timber, soil, and wildlife conservation."

The Whites were public-spirited Montanans who strongly appreciated nature. According to correspondence about the donation, they feared someone might buy the land and tear out the trees, leaving a scarred backdrop for Kalispell.

For the next 10 years, the land remained under jurisdiction of the State Board of Land Commissioners because, according to the board, the area did not have "sufficient outstanding features to justify creating a

TERRY KNUPP

TERRY KNUPP

Although it is only 10 minutes by car from Kalispell, Lone Pine State Park offers some of the finest scenery and solitude around. It also offers an interpretive trail; a stunning view of the Mission, Swan, and Whitefish ranges; and meeting rooms in the new visitor center. The meeting rooms are available to citizen groups, schools, or clubs for their activities.

state park." During that time, Lone Pine was administered by the state forester's office as forest land.

Community Contributions

Some Kalispell residents were concerned that if the area remained under the land board, alterations and conflicts with recreational use could occur. They also remembered the Whites' original wish that the area become a state park.

With the help of the Kiwanis Club and others, Kalispell attorney Forrest Rockwood began a petition drive to make Lone Pine a state park by transferring control of the area to the State Park Commission. The effort was successful. In 1955, with ceremonies at the Flathead County Fairgrounds, the new park was dedicated. In the late 1950s, latrines and picnic tables were installed.

Unfortunately, vandalism plagued the park in the years that followed. Toilets were smashed; picnic tables and car bodies were thrown over the cliffs; trees were cut down or scarred; motorcycles and 4X4s left their tracks behind; and refuse from bonfires and keggers began to pile up. Because of limited funds, it was a state park in name only.

In 1968, Dan Korn, Sr., a Kalispell attorney, contacted the Department of Fish, Wildlife and Parks to complain that the Whites' vision had not yet been developed. He was told that funding was difficult, but he pressed the state to develop and publicize a long-range plan for the area. He believed local support and legislative action would follow. He was right, but the effort took nearly 14 years.

In 1970, Anthony Beuchel, then parks manager for Region 1 (Kalispell), proposed the concept of a year-round environmental education center and outdoor recreation area at Lone Pine. In 1972, the Kalispell Kiwanis Club—with Rockwood once again taking the lead—donated money for an interpretive display; in 1975, Flathead County black-topped the half-mile road to the park property.

In 1978, the Department of Fish, Wildlife and Parks hired geologist Lex Blood and biologist Michael Britton, both of Flathead Valley Community College, to study Lone Pine. They examined existing uses and recommended development as an "urban recreational facility oriented to individual, family, or group use, stressing scenery, solitude and proximity to a densely populated area."

In 1981, the Kalispell Rotary Club and the department collaborated to obtain funding to develop the park. They received agreement and support from the Flathead Valley's legislative delegation. The 1981 Montana Legislature recognized the community's consensus and appropriated funds to develop parking and picnicking facilities, a visitor center, and a trailer pad for the caretaker. In 1982, the Boy Scouts presented the five acres given to them by the Whites to the state for inclusion in the state park.

The facilities developed through the legislative appropriation were complemented by volunteer work and financial donations. During the summer of 1984, six 14-year-old Kalispell residents, volunteering through the Community Action Program, cut and leveled an interpretive trail to the lookout. The Kalispell Rotary Club and Kalispell Pole and Timber provided materials for a footbridge. The department's maintenance crew put the bridge together and asphalted the trail to one overlook so those in wheelchairs could also enjoy the view from Lone Pine. *continued on page 10*

Gas Bubbles On The
A Deadly

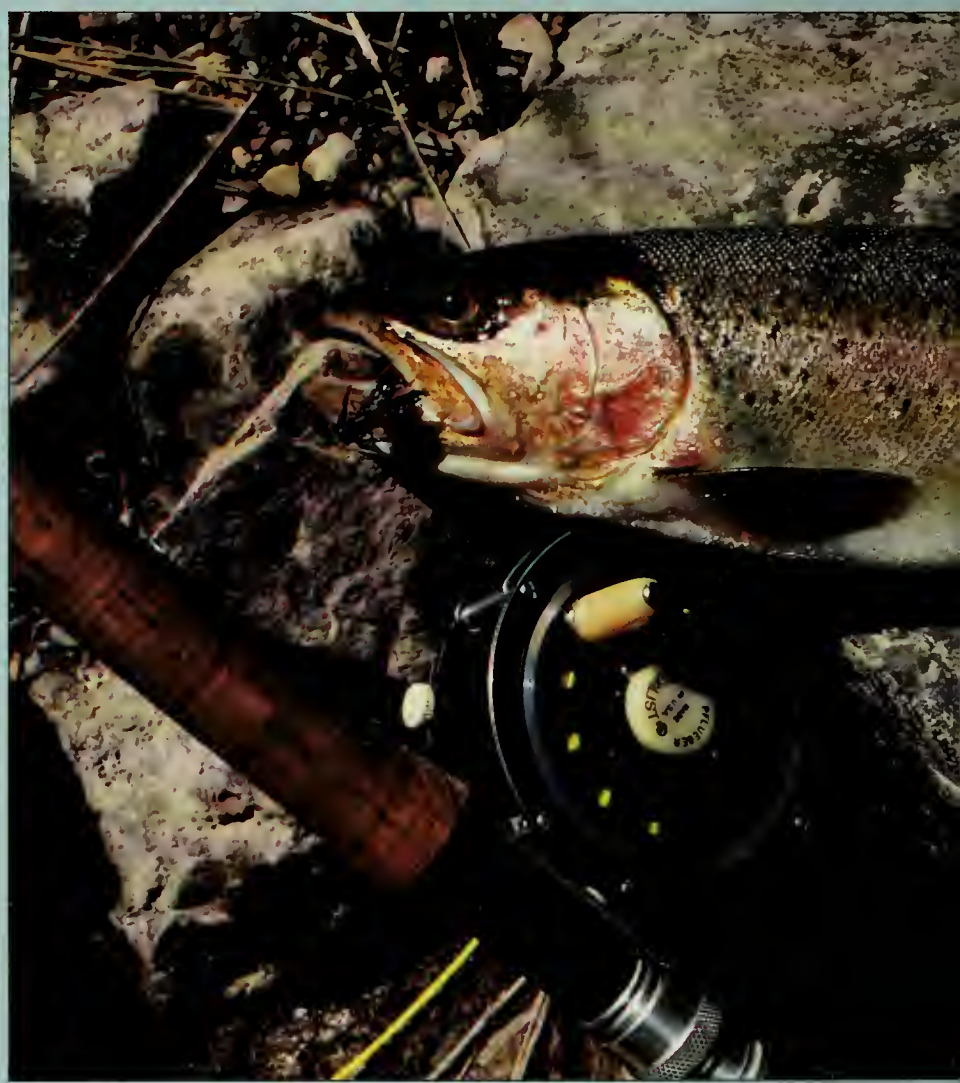
by Wade

Nitrogen. It's everywhere around us, making up 78% of every breath we take. But, in its gaseous form, it is also doing sinister things to one of Montana's most productive trout streams, the Bighorn River. Gas bubble disease is a well-known but little understood malady caused by excess nitrogen gas dissolved in the water. Fish that "breathe" this water get unwanted nitrogen in their bloodstream. When the gas laws that we learned about in high school physics take over, the result is that this excess nitrogen forms gas bubbles while working its way back out of the fish. The end product is gas bubble disease, a phenomenon very much like the "bends" that afflict human divers.

When the amount of gas dissolved in the water exerts pressure equal to the pressure exerted by the atmosphere, the gas in the water is said to be at saturation level, and no problem occurs. However, any more gas results in "supersaturation," creating hazards for the fish. Supersaturation of oxygen is common in aquatic systems. Plants are constantly producing oxygen through photosynthesis, even under water. Fish are biologically equipped to utilize or eliminate excess oxygen, so no problem occurs. Too much nitrogen is a different story, because fish cannot efficiently remove it from their systems.

On the Bighorn River, the source of the supersaturated water is Afterbay Dam, a small reregulating structure downstream from the main Yellowtail Dam. As turbulent water from the Afterbay jets out through the sluiceway, it traps air which is carried deep into the stilling basin and forced into solution under pressure. This supersaturated water then spreads out placidly downstream where it produces a menacing threat to unsuspecting fish populations.

Gas bubble disease was first discovered in 1901 and was the subject of considerable research in fish hatcheries for the next 70 years. It wasn't until the early 1970s, however, that a serious problem was recognized on some of our major river systems. Gas bubble disease on the Columbia River annually destroys millions of adult and juvenile anadromous fish (salmon and steelhead). A serious gas bubble disease problem existed on the



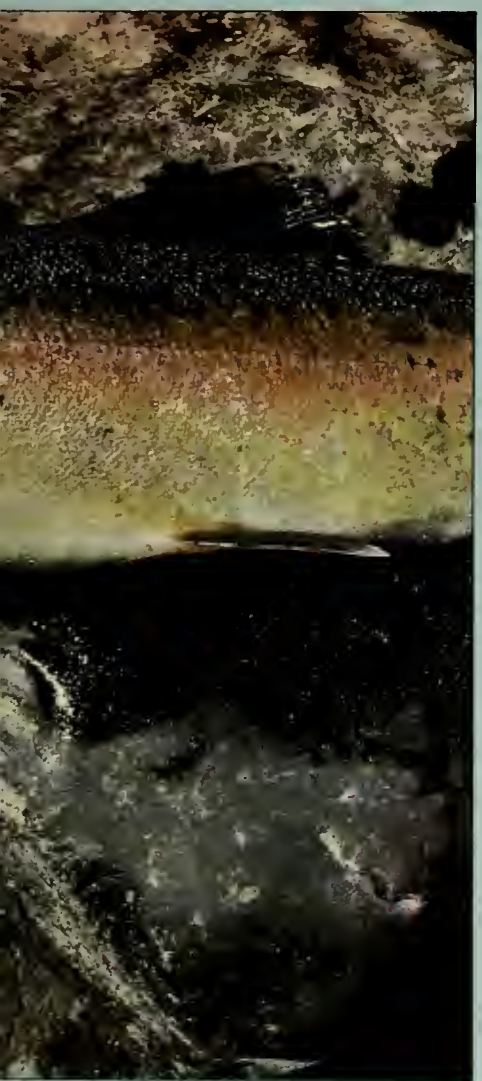
DAVE BOOKS

Gas bubble disease—a problem caused by excess nitrogen gas dissolved in the water—is the biggest problem facing the Bighorn River fishery today. Caused by supersaturated water emanating from the Afterbay Dam (right), the disease manifests itself most often as blisters of nitrogen gas that form in fishes' tissues or on their skin (far right.)

WADE FREDENBERG

Bighorn: Mystery

Fredenberg



BILL PRYOR

Kootenai River at Libby Dam in the early 1970s as well, until the problem was rectified with installation of turbines in the dam. Gas bubble symptoms also were recognized on the Beaverhead River below Clark Canyon Dam during 1984.

Gas bubble disease was first observed on the Bighorn in 1972 when a major trout die-off occurred. Between 1972 and 1983, sporadic outbreaks were documented. A two-year study of the problem conducted by the U.S. Fish and Wildlife Service in 1981-82 confirmed that Afterbay Dam was the source of the problem and that the problem was indeed severe. In June 1981, a sample of fish taken by electrofishing revealed that 72% of the brown trout showed symptoms of the disease.

What are these symptoms? In this case, a picture is truly worth a thousand words. One of the most common symptoms is the so-called "popeye"—an eyeball forced to protrude from its socket due to pressure from gases building up behind the eye. On the Bighorn, however, the problem is most frequently exhibited as varying numbers of bubbles or blisters of nitrogen gas that form in the fishes' tissues. Frequently, these bubbles are obvious on the fins and head or inside the gill covers or mouth. In severe cases, the bubbling may nearly cover the fish, resembling the bubble-pack material used in wrapping fragile items for shipping. These external lesions frequently rupture, causing blindness and creating open wounds that serve as a pathway for other infections and fungi.

Even more serious are the internal bubbles in the bloodstream which block capillaries, causing tissue and internal organs to die from lack of blood. In some cases the blood becomes a frothy fluid and eventually the heart can no longer pump the mixture and the fish dies.

Fortunately, not all the fish are affected to the same degree and many survive with mild cases of the disease. Fish can alleviate the symptoms by dropping into deeper water where the pressures force more gas back into solution where it is no longer harmful. Whether or not the fish can sense this escape is uncertain. In cage tests where fish were confined to shallow water on the Bighorn in May of 1984, over 75% died within the first week of exposure.

The overall health of the aquatic life in the Bighorn may be affected more profoundly than current evidence can document. The fishery is prospering, but there are disturbing problems, particularly in that three-mile reach of stream where gas bubble disease has been most severe. Larger brown trout show exceedingly poor condition; in other words, they are "skinny." Brown trout over four pounds are as rare as two-pounders are common. It is also these larger brown trout which show the most serious disease symptoms when outbreaks occur.

The Bighorn harbors very few whitefish, a species known to be extremely susceptible to gas bubble disease but one that may provide important forage for trophy-sized brown trout. How the gas affects aquatic insects and forage minnows is a question mark. Another riddle: Why do rainbow trout in the Bighorn have a history of poor spawning success? The spring spawning habits of rainbow coincide with the period when the gas problem is usually most severe; this could be the answer.

What does all of this mean to the angler? For one thing, gas-bubble-diseased-fish are perfectly safe to eat. However, fish under stress from this problem become more difficult to catch and, in the more severe cases, they probably stop feeding entirely. From the fisherman's perspective, the crucial point is that gas bubble disease may be the major factor limiting the trophy potential of brown trout in the upper portion of the Bighorn River. In fact, the gas problem is the single biggest problem on the Bighorn River today, bar none.

So why don't we solve the problem? It's not that easy, I'm afraid. The Bureau of Reclamation owns the dam and in 1983, it designed and installed some "flip-lip" structures, at a cost of tens of thousands of dollars, to alleviate the gas problem. The flip-lips partially reduced the gas by breaking the force of the plunging water and pushing it to the surface, but the gas problem was not eliminated; later, the flip-lips had to be removed due to structural problems which threatened the integrity of the dam. A number of other retrofit techniques are currently being

modeled in an attempt to find something that will reduce the gas to acceptable levels. At present, building a rock cascade downstream from the dam—which would remove gas by creating a shallow, tumbling flow over a rough surface—looks like the most promising proposal.

BILL PRYOR

Lesions formed by gas bubble disease frequently rupture, creating open wounds that admit other infections and fungi. But even more serious are bubbles in the bloodstream, which block capillaries and interfere with the fishes' circulatory system.

Gas on the Bighorn—how do you spell relief? Experts agree that the ultimate solution is installation of a turbine in the Afterbay structure that could dissipate the energy and eliminate air entrapment. Authorization for this project has been awaiting congressional approval for several years and, while it is getting closer, the current political austerity program makes it difficult to obtain authorization for projects like this. It is indeed ironic that in this case, "lack" of power production is threatening one of Montana's most valuable stream resources. The potential exists here to produce power and actually benefit the fishery—a rare opportunity for conservationists and developers to help each other out. The Bureau's power plant proposal needs strong support.

In the meantime, the Bureau has recognized the Bighorn as a useful study site for development of some badly needed answers to questions about gas bubble disease: its causes, symptoms, and cures. For the next four years, the Bureau of Reclamation is funding a study of the problem to be carried out jointly by the Montana State University Cooperative Fishery Research Unit and the Department of Fish, Wildlife and Parks. We are confident the problem can and will be solved to produce an even rosier future for the Bighorn and other streams with "gas pains." ■

Scenery and Solitude *continued*

State park employees volunteered their time to assist the 391st Engineer Company of the Army Reserve in removing old car bodies and other litter that had accumulated under the overlook cliffs. The Flathead Chapter of the Audubon Society, the Flathead Order of Eagles, Trout Unlimited, the Flathead Chapter of the Montana Wilderness Association, Flathead Wildlife, Inc. (in memory of Hollis Broderick), and the American Society of Foresters donated money and information for interpretive trail signs. Lone Pine State Park is becoming permanent testimony to the investment, persistence, and cooperation of the Kalispell community.

The Visitor Center

Citizens who supported development of Lone Pine envisioned a visitor center for environmental education and a variety of public gatherings that would be enhanced by the scenic setting. The structure was designed to blend into Lone Pine's natural features and to provide multiple-use indoor space. Two meeting rooms have large picture windows encompassing the view. One room has formal tables and chairs for about 100 people. The other has several comfortable couches surrounding a wood stove.

The interpretive theme for the park is "to enhance human appreciation of the Flathead area's natural resources." While some simple interpretive displays may be installed in the center in the future, the building will be maintained for flexibility. Supporters did not want a stagnant, unchanging interpretive center, but rather one that would extend in dynamic fashion the concept of early conservationist Aldo Leopold, who said, "Recreational development is not a job of building roads into lovely country, but of building receptivity into the still unlovely human mind."

Although some education programs will be conducted at Lone Pine, its primary use will be by citizen groups, schools, and clubs. Through their individual activities, groups will serve their own needs and interests. Some groups may bring in natural history experts, while others may appreciate the natural beauty simply by being at Lone Pine.

Over the next few years, more improvements will be sought for the state park through community contributions and possibly legislative appropriations. These improvements may include a natural outdoor amphitheater or classroom, a hiking trail from town to the lookout, and multimedia equipment for the visitor center. Each year, a public meeting will be conducted to discuss current and future management of the park.

Cooperative Management

Administration of Lone Pine State Park is a joint effort of Flathead County and the Montana Department of Fish, Wildlife and Parks. The Flathead County Parks and Recreation Department employs a programmer who encourages and schedules center use. She also supervises volunteers who keep the center open during visitor hours and sell souvenirs. Revenue generated from these sales and from group-use fees fund the center's operation.

The Department of Fish, Wildlife and Parks employs a park attendant who maintains and provides security for the park and visitor center.

Cooperative management has enabled both Flathead County and department personnel to more efficiently serve the public in their areas of expertise.

Getting There

The visitor center and overlook trail occupy only about one-fifth of the 162-acre park. The remaining space is a combination of Douglas-fir forest and open meadows, providing opportunities for hiking, nature study, and horseback riding. Several picnic tables nestle in shaded spots under the trees.

The next time you visit Kalispell, take an extra half-hour to see for yourself what the Whites thought so much of over 40 years ago. If you live nearby, schedule your next group activity at the visitor center; to schedule the visitor center, phone 755-5300, ext. 347.

Lone Pine State Park is a five-mile drive southwest of Kalispell. From U.S. Highway 2 in Kalispell, turn south on Meridian Road to Foy's Lake Road (Secondary 503). After about four miles, turn left at the state park sign, opposite Foy's Lake. ■

Bivouac By Terry Knupp

When the evening light dropped beneath the horizon of Froze-to-Death Plateau in the Beartooth Mountains, I realized I would be spending the night in a bivouac. A bivouac ("biv-wak") is a camp with little or no shelter used only for a short time, but, if necessary, overnight.

My friend Connie and I had been hiking all day to accomplish our goal—climbing to the top of Granite Peak. Although we were successful, it took us longer than we anticipated to return to our base camp. At 10 p.m., we still had two miles of boulder-strewn plateau to cross before reaching our tent. We tried for 20 minutes to go on with the aid of Connie's flashlight, but when she accidentally dropped it and it shattered, finding secure footing became impossible. We decided the risk of injury from slipping on the rocks in the dark was greater than attempting to survive a bivouac, even though we were ill-equipped. Given its name—Froze-to-Death Plateau—the thought of spending the night there was not pleasant, but we really had no choice.

Hearing thunder in the distance, we sought cover in a large crack formed by two car-sized boulders. Our day packs would not fit, so we left them outside. About 15 minutes later, I had already drifted into an exhausted sleep, but Connie felt claustrophobic. She got out from under the boulders and sat down in the open about 10 feet away. I could not see her in the darkness, and I thought I should check to see if she was all right. As I began to walk toward her, I stepped off a boulder and fell about four feet, flat on my face. I screamed in rage and surprise, before I realized I was okay. We laughed at ourselves and recovered some sanity.

We huddled together beneath Connie's rain fly, trying to get comfortable on the cold, sharp boulders. About two hours later, I said, "I wish I had my space blanket that's back at the tent." That prompted Connie to remember that she had one in her day pack. We had forgotten all about our packs. We retrieved them, ate some leftover lunch, drank water, and covered up with the space blanket until the sun rose.

What could we have done to better prepare ourselves for a bivouac? What did we do right that helped us get through the bivouac?

How to Prepare for a Bivouac

Survival is a collective art. Perhaps we made the most important decision about our bivouac before the hike: Go with someone else. How often are you tempted—when no one else has time to go, or nobody else wants to hike where you do—to go alone? During the night of our bivouac, emotional and mental control shifted from one person to the other, resulting in a stable balance that would have been difficult to achieve alone. Logical thoughts, like remembering the space blanket or deciding to eat some leftover food, came slowly. Sharing some moments of humor about the situation kept our spirits up and helped the time pass.

The other aspect of our successful bivouac was what we wore and carried in our day packs. We had minimum gear, but it saw us through the night. A more complete list of bivouac essentials includes: *clothes*—wool pants and hat, down vest, mittens, windbreaker, sweater; *shelter*—poncho or rain fly, space blanket, foam pad; *miscellaneous*—flashlight, extra flashlight, extra food and water, waterproof matches, pocketknife, first aid kit, toilet paper, contact lens case/glasses.

If you find yourself in a bivouac situation, the timing of your decision to stop can be important. Stopping an hour before dark will make it easier to find a spot which is as dry, level, and sheltered as possible. The hour will also leave time to prepare something to eat. Food will help you sleep better and stay warmer. Drink water because you may be dehydrated from the day's exercise.

Use your companion's body heat to keep warm, by sitting or sleeping close together. When you get cold, flex your muscles until you begin to breathe heavily. Swinging your arms and legs may actually force warm air away from your body. Psychological tricks like counting to yourself, singing old musicals, or thinking about the good things in life can help pass the night. Eventually, dawn will come and your bivouac will be over.

Self-Discipline: What Works for You

Many hikers today are knowledgeable about what to take on a hike and what to do in emergencies. But do we practice what we know? If survival is an art, perhaps there are simple techniques we can develop to help us become survival artists.

I do not like to prepare for a hike for three hours before going; I like to decide to go—and then GO. For me, survival art is best practiced on a rainy day before hiking season begins by preparing and loading a day pack. Then it is always ready, and I can grab it on my way out the door.

For others, the art is taking the time to pack carefully during the hours before leaving. True artists know what techniques work best for them—and they use them.

SUGGESTED READING

Foster, Lynne, "Mountaineering Basics," Avant Books, San Diego, 1982.

Fear, Gene, "Surviving the Unexpected Wilderness Emergency," Survival Education Association, Tacoma, 1975.

Olson Named F&G Commissioner

Gov. Ted Schwinden has appointed Dr. James Olson, a Hamilton dentist, to the Montana Fish and Game Commission.

Olson is a director and past president of the Ravalli County Fish and Wildlife Association; he served as second and first vice president of the Montana Wildlife Federation and currently is an associate director. He received a B.A. from Jamestown College in Jamestown, N.D., and a doctorate in dentistry from Case Western Reserve University, Cleveland. He taught biology at Havre High School from 1963 to 1966, and began practicing dentistry in Hamilton in 1973. He is president of the Montana Board of Dentistry. Olson succeeds Earl L. Sherron of Missoula on the five-member Fish and Game Commission.

Gov. Schwinden also reappointed Don Bailey, Forsyth, and Dan Oakland, Great Falls.

Bailey operates the family ranch south of Forsyth where he raises purebred Herefords and commercial feeder cattle. He is a member and past chairman of the Rosebud-Treasure Wildlife Federation and served on the Department of Fish, Wildlife and Parks' Landowner Relations/Sportsmen Access Advisory Council. He was first appointed to the Commission in 1981.

Jim Olson

Oakland, an avid hunter and fisherman, is an insurance agent with Northwestern National Life Insurance Company in Great Falls. He is a member of Ducks Unlimited and a life member of the Great Falls Trap Club. He is active in civic and professional organizations in Great Falls and was first appointed to the Commission in 1981.

Holdover members are current chairman Spencer Hegstad, Dillon, and Bob Jensen, Circle.

Juanita A. Fanning of St. Ignatius with her state record 8-pound, 2½-ounce largemouth bass taken in Milnor Lake near Troy.

Parks Caretakers: Very Important Persons

Montana has 72 state recreation areas, 10 state parks, 18 state monuments, and 232 fishing access sites—332 units. In 1984, these attractions compiled more than 4.5 million visitor days, a 1% increase from the 1983 figure. Statewide, less than 50 caretakers oversee these 332 sites—some of the caretakers are responsible for more than one site, while some sites have no caretaker.

Each caretaker is responsible for his or her site or sites. Whenever a major repair or improvement is made, the caretaker and his crew help with the job. The caretaker is also responsible for grounds maintenance and repair, garbage and litter pickup, mowing, servicing latrines, painting, collecting camping fees, taking water samples, and other duties.

The caretakers are a critical link in determining the way the public feels about the parks system, and about the Department of Fish, Wildlife and Parks. They are highly visible when an individual enters a park, and will probably be the first one to say "Hi," and "Welcome." Because they are constantly asked questions about a wide range of subjects, they must be aware of the numerous rules and regulations pertaining to every aspect of

1984

With a new stonecat record of 0.30 pounds (caught in the lower Smith River), and the addition of the blue sucker (caught in the Marias River at Loma) to Montana's record fish list, you'll see Ray Quigley's name three times on the chart — he's also the winner in the shovelnose sturgeon category. Quigley is president of the Great Falls Chapter of Walleyes Unlimited.

The 1980 channel catfish record was broken by Gordon Wentworth of Livingston. His 25.89-pound channel cat was caught with a sucker minnow and exceeded the previous record by more than two pounds.

Juanita A. Fanning joined the state records list when she caught an 8-pound, 2½-ounce largemouth bass in Milnor Lake near Troy. Fanning, from St. Ignatius, caught her record fish on a jitterbug. The previous record had stood since 1980.

Neil Berg's 1974 walleye record was tied on Jan. 29, 1983, when Jim Carver of Malta matched Berg's 14-pound catch. Both fish were taken in Nelson Reservoir.

In 1984, one species was added to the Montana records list, three records were broken, and one record was tied (with a fish taken in 1983, but not verified until 1984). What do you do if you think you've caught a record fish? The Department of Fish, Wildlife and Parks requires that you (1) harvest the fish legally, (2) weigh it on an inspected scale (most grocery store scales are inspected), and (3) have the fish positively identified. *Whenever possible,* that means verification by department personnel. If you can't find a department employee, you must present a photograph from which the fish can be properly identified; with some species, this is difficult. If you didn't have a department employee weigh the fish, you must present documentation from the store where it was weighed.

FISHING RECORDS SUMMARY

Species	Weight lbs.	Weight ozs.	Angler	Year	Location
Arctic grayling	2	10	Mark Daniels	1974	Handkerchief Lake
Bigmouth buffalo	32	6	Gary Lundman	1979	Missouri River (Slippery Ann Game Station)
Black bullhead	1	11	Mike Mitchell	1977	Horse Creek (McCone Co.)
Black crappie	3	2	Al Elser	1973	Tongue River Reservoir
Bluegill	2.64		Brent Fladmo	1983	Peterson's Stock Dam
Blue sucker ***	**6.05**		**Ray Quigley**	**1984**	**Marias River at Loma**
Brook trout	9	1	John R. Cook	1940	Lower Two Medicine Lake
Brown trout	29	0	E.H. "Peck" Bacon	1966	Wade Lake
Bull trout	25	10	James Hyer	1916	unknown
Burbot (ling)	13	4	Paul Keller, Ernie Schutt	1980	Missouri River (below Fort Peck Dam)
Carp	38	4	Craig Dyer	1983	Eyraud Lakes
Channel catfish *	**25.89**		**Gordon Wentworth**	**1984**	**Fort Peck Reservoir**
Coho salmon	4	14	Irven Stohl	1973	Fort Peck Reservoir
Cutthroat trout	16	0	William D. Sands	1955	Red Eagle Lake
Freshwater drum	13	12	Kelly Monson, Mike Garten	1981	Milk River (near Vandalia Dam)
Golden trout	3.14		Terry Cameron	1981	Inlet, Lake At Falls
Goldeye	2	9	Lester Estenson	1977	Nelson Reservoir
King salmon (chinook)	4	7	Barry Gillis	1972	Missouri River
Kokanee (salmon)	5	15	Forrest Johnson	1976	Pishkun Reservoir
Lake trout	42	0	Dave Larson	1979	Flathead Lake (east shore)
Lake whitefish	5	8	James Sellen	1981	Echo Lake
Largemouth bass *	**8**	**2½**	**Juanita A. Fanning**	**1984**	**Milnor Lake**
Mountain whitefish	4	9¾	Mike Hangas	1977	Blackfoot River
Northern pike	37	8	Lance Moyler	1972	Tongue River Reservoir
Northern squawfish	6	10	Rick Norris	1979	Flathead Lake (Polson Bridge)
Paddlefish	142	8	Larry Branstetter	1973	Missouri River
Pallid sturgeon	60	0	Gene Sattler	1979	Yellowstone River
Pumpkinseed	0.61		Mac Vinnedge	1982	Rouselle Slough, Flathead River
Pygmy whitefish	0.16		Orlin Iverson	1982	Ashley Lake
Rainbow trout	20	0	C.J. Brohaugh	1952	Cliff Lake
Rainbow-cutthroat hybrid	30	4	Pat Kelly	1982	Ashley Lake
Sauger	7	2	Raymond V. Johnston	1975	Tongue River Reservoir
Shortnose gar	3	1	John Johnson	1977	Fort Peck Dredge Cuts
Shovelnose sturgeon	13	1	Ray Quigley	1983	Marias River at Loma
Smallmouth bass	4	11½	Bob Higson	1975	Horseshoe Lake
Smallmouth buffalo	9	4	Mac McKinney	1977	Hauser Lake (west side)
Stonecat *	**0.30**		**Ray Quigley**	**1984**	**Smith River (lower)**
Walleye **	14	0	Neil Berg	1974	Nelson Reservoir
	14	**0**	**Jim Carver (tie)**	**1983**	**Nelson Reservoir**
White crappie	2	2	Drew Jackson	1978	Tongue River Reservoir
White sturgeon	96	0	Herb Stout	1968	Kootenai River
White sucker	4	5	Fred Perry	1981	Nelson Reservoir
Yellow perch	2	0	Gerald Pottratz	1974	Nelson Reservoir

*** New Montana record for 1984**

**** Montana record tied**

***** New species added to Montana record list**

parks recreation.

Thus, a typical parks caretaker's duties go far beyond "maintaining and cleaning" a site—he or she is a representative of the department. A lazy, cranky, uncaring caretaker could quickly "turn off" visitors, no matter how attractive, clean, or maintained the site. So, in a real way, the caretaker is responsible for the safety, happiness, and pride in a state park system that all Montanans should be able to boast about.

Caretakers have that certain "something" it takes to remain calm when an irate camper wants to know why Uncle Joe didn't get a moose permit again this year. Or why Aunt Helen (who is confined to a wheelchair) can't catch more than five fish from the Missouri River. The favorite complaint, however, is: "That guy's dog is running loose, and it just ate all the hamburgers off my grill!" Caretakers hear it all, and see it all, yet they are a non-complaining group of people who try to maintain their sense of humor.

They enjoy their work, they do a good job, and they are proud of what they do. They are part of the system that enables all of us to enjoy the special outdoor activities offered to us in Montana.

So the next time you are enjoying Montana's waterways, state monuments, parks, or recreation areas, don't hesitate to say "hello" to the person in the Department of Fish, Wildlife and Parks uniform. You will meet a "Very Important Person"—who is a friend of parks and one who extends Montana hospitality.—*Debbie Cheek, Region 4 (Great Falls) Parks Division administrative assistant*

BOOK REVIEWS

GROUSE OF THE NORTH SHORE, by Gordon Gullion, photography by Tom Martinson, Willow Creek Press, 801 Oregon St., Oshkosh, WI 54901; 1984, 160 pages, $39.00, hard cover.

The ruffed grouse has inspired more literary efforts, perhaps, than any upland game bird in North America, and probably the world (bobwhite quail fans may argue). And sometimes it seems as if ol' ruff has been the subject of more scientific scrutiny than the solar system. Yet, as premier grouse expert Gordon Gullion admits in this book, "After working with ruffed grouse for a quarter century, I guess I am most impressed by just how little we still really know about these birds, and how they cope with all the problems they must face daily." One thing seems certain: What Gullion doesn't know about ruffed grouse probably isn't worth knowing. And in this book, he has distilled, in his relaxed, readable style, the results of studies of ruffed grouse biology and aspen management spanning more than 25 years.

But what will really knock your socks off are Tom Martinson's superb color photographs. I've prowled around the woods with a camera long enough to know that ruffed grouse are difficult to photograph. They are shy, secretive birds that take advantage of dense cover and the camouflage it provides. Poor lighting conditions—the bane of the wildlife photographer's existence—are the rule rather than the exception. But somehow Martinson has managed to compile a collection of photos portraying every facet of the grouse's life cycle—courting, nesting, rearing young, feeding, flying, and falling prey to natural predators—that is simply unparalleled.

This is far more than an expensive coffee table book; it is a book with an intellectual and visual message, and if you are a fan of the ruffed grouse, it should be in your library.—*Dave Books, editor*

RIDGE RUNNERS AND SWAMP RATS, by Charles F. Waterman, The Amwell Press Inc., 65 Old Route 22, Clinton, NJ 08809; 1983, 347 pages, $27.50, hard cover.

A collection of 50-odd stories and articles on everything from bird dogs to tarpon fishing to outdoor photography, "Ridge Runners and Swamp Rats" will keep you grinning from the first page to the last.

If you are, like I am, an unabashed Charley Waterman fan, you'll recognize some of these pieces from other sources, such as *Gray's Sporting Journal, Gun Dog*, and Charley's various books. You'll also recognize the customary Waterman trademarks: subtle humor, accurate description, and down-to-earth writing style. Waterman's dogs don't always behave perfectly, he doesn't always land the big fish, and he freely admits he's not the world's greatest wingshot. But when he does well, he'll share his jubilation with you, too.

To read Waterman is to go along with him, floating an Ozark river, navigating a Florida mangrove swamp, or fishing a Montana spring creek. He'll point out the sights along the way, and the trip turns out the way it turns out—no promises, no apologies. At the end you will realize you have learned something without having been lectured, and entertained without having been slapped on the back. The stories in "Ridge Runners" are honest, human, and funny, and more than that a reader cannot ask.—*Dave Books, editor*

BIRDS OF THE NORTHERN ROCKIES, by Tom J. Ulrich, Mountain Press Publishing Co., P.O. Box 2399, Missoula, MT 59806; 1984, 160 pages, $7.95, soft cover.

This book includes descriptions of more than 170 species of western birds and more than 220 excellent color photographs, most of them by author Tom Ulrich. While most field guides rely on art work for illustration, actual photographs have some advantages. They add an element of realism in that the camera records a bird much as the human eye sees it. This book, which will fit nicely in a glove compartment or coat pocket, is a welcome addition to the guides available for bird watching in the Rocky Mountain region.

THE ANGLER'S GUIDE TO MONTANA, by Michael S. Sample, Falcon Press Publishing Co., P.O. Box 279, Billings, MT 59103; 1984, 244 pages, $8.95, soft cover.

Writing an angler's guide to Montana—a state with diverse aquatic habitats and more than two dozen species of game fishes—is no simple undertaking. At last count, there were more than 9,000 rivers, streams, spring creeks, lakes, and reservoirs in the state. These vary from clear, cold alpine lakes and streams to warmwater reservoirs and meandering prairie creeks and rivers. Fishing opportunities vary from dry fly fishing for trout or grayling on blue ribbon streams like the Madison and Gallatin to soaking a gob of nightcrawlers for shovelnose sturgeon or channel catfish on the lower Yellowstone or Tongue.

Mike Sample's book doesn't attempt to cover every tiny lake and stream, but instead concentrates on Montana's larger fisheries. It describes 16 of the major trout streams and 70 of their tributaries plus 108 of the best lakes and reservoirs in the state. Special sections on Glacier and Yellowstone National parks are also included. An amalgam of Sample's knowledge and experience, plus that of several other authors, the book contains useful information and advice from more than 60 guides, biologists, and veteran anglers. Well illustrated with black and white photos and helpful maps, the book is a valuable reference for old hands at fishing Montana's waters as well as those who are just starting out.—*Dave Books, editor*

CAPTURING NATURE WITH A CAMERA

story and photos by Keith Szafranski

"I wish my camera could take pictures like that!" This is what I hear all too often as I watch people viewing a beautiful photograph. The fact is, most modern cameras are capable of producing excellent photographs if the person operating the shutter release is knowledgeable. The camera, lenses, and myriad photographic accessories available today are only tools which, when used properly, can reveal details, evoke mood, and capture the essence of the natural world in which we live. The following paragraphs give a basic understanding of which tools are most useful to the outdoor photographer and how to use them.

By far the most versatile camera for nature photography is the 35mm single lens reflex (SLR). With the great variety of lenses and accessories available for the SLR, you can build a "system" for practically any aspect of outdoor photography. Also, the SLR lets you view your subject directly through the lens, so you will know exactly what you are shooting. In this age of computer designs, the major brands of 35mm SLR cameras are all capable of some amazing feats. To select the model that best fits your needs and pocketbook, consult a recent photographic buyer's guide or

visit your local camera store. The staff will help you make the right choice.

The 50mm lens sold with most 35mm cameras is perhaps the least useful to the nature photographer. It is not wide enough to take in sweeping landscapes nor long enough to photograph large animals at a safe distance. If you can, purchase the camera body without this lens and put the money saved toward a more useful set of optics. One option you might consider is the 50-55mm macro lens. A macro lens is specially designed to let you focus closer than a standard lens, enabling you to obtain a large film image of small subjects.

Each manufacturer of quality lenses offers a wide range of focal lengths to supply a variety of needs: 20-35mm for wide expanses, 50-200mm (preferably macros) for easily reached subjects like flowers and butterflies, and 300-500mm telephotos for distant or wary subjects. If you would like a variety of focal lengths but have a limited budget, a zoom lens might be the answer—an 80-200mm would be a good choice. Whatever your bank account, be sure to fit the lens to the subjects you will be photographing most.

The film you use often governs what you can photograph and the quality of the final image. Slower films (ASA 25-100) result in photos of greater sharpness and color saturation, while faster films (ASA 200-1,000) will let you shoot moving subjects under poorer light conditions. A personal choice must be made. Do you want the extra quality the slower films give, or would you rather sacrifice some quality to get more pictures?

After answering that question, you must then decide whether to use slide or print film. If you want to know exactly how you are doing in the handling of your equipment, shoot slides. With slides, any mistakes you make will be apparent. If you know what you did to make a particular photo, you will be able to figure out where you went wrong and can improve on your next try. With print film, however, a lot of mistakes—especially improper exposure—can be improved by the printing machine and these good results can be misleading.

If you want the highest quality and want to keep track of how you are

The top photo (marmot) combines an interesting subject, good lighting and composition, and a distraction-free background. The forest floor (center) required a small aperture (large f/number) to increase depth of field and capture all the details. A tripod and cable release ensured a sharp picture even at the slow shutter speed required (¼ second, f/22). The bottom photo captures an eared grebe hen with a pair of young on her back. These photos were all taken with Kodachrome slide film.

doing, use one of the slower slide films like Kodachrome 25 or 64. They have long been the standards by which other slide films are measured and are the films desired by most magazine editors. But try a number of different films, choose your favorite, and stick with it. Constantly changing film or equipment will only make your photography more difficult. (When changing to a different speed film, don't forget to change the ASA dial on your camera.)

How do you consistently obtain sharp pictures using such slow films? The answer lies on three legs: a tripod. With your camera firmly attached to a good tripod, you can safely shoot at slower shutter speeds or use longer lenses without a loss in quality. Most professional nature photographers use a tripod whenever they can. Also, when using a tripod, use a cable release to trip the shutter to further eliminate camera movement. Use of these two devices alone could improve your photography manyfold.

When carrying a tripod is impractical, as it is with some wildlife photography endeavors, there is another method to ensure against camera shake. When hand-holding your camera, select a shutter speed at least equal to the focal length of the lens you are using. A 50mm lens would call for a shutter speed of 1/60 of a second or faster, while a 400mm lens would require at least 1/500 of a second. Using a slower shutter speed without the aid of a tripod will be inviting disaster.

Next to camera movement, the most common mistake made by amateur photographers is improper exposure. The amount of light reaching the film is controlled by two factors: aperture size and shutter speed. The aperture, described in f/numbers (2, 2.8, 4, 5.6, etc.) on the lens barrel, is the opening in the lens which admits light (the lowest number indicates the largest aperture, with each f/number allowing half as much light to reach the film as the next lower number). The shutter speed (1/60, 1/125, 1/250, etc.) controls the amount of time the shutter is open.

The distance from one f/number or shutter speed to the next is called a stop. When you change exposure from f/8 to f/11, you have decreased

A trophy mule deer buck makes a prize-winning photo every time. Big game animals are most easily approached in national parks and wildlife refuges.

exposure by one stop. The same is true when you change shutter speed from 1/125 to 1/250. Working together, aperture and shutter speed determine proper exposure. If you increase one, you must decrease the other by the same number of stops to get the same exposure. Thus, if your meter says that a proper exposure for a shot is 1/250 at f/4 and you decrease aperture size one stop to f/5.6, you must also increase the time the shutter is open by one stop to 1/125 to obtain the same exposure.

All that may seem simple enough, especially with today's automatic cameras. However, the meter in your camera is set to give proper exposure to "average" scenes, and many scenes are not average (snowy landscapes are a good example). To overcome this drawback, you need a camera that you can either use on manual or on automatic override. Then take your meter reading from an "average" scene to get the proper exposure before shooting your subject. There are a number of "average" scenes in nature, such as green grass and grey tree bark. You could also carry a Kodak grey card and take your reading off it. Whatever you use, be sure it is in the same light as your subject. This procedure, called substitute metering, will ensure proper exposure of even the most difficult subjects.

Another handy item in determining exposure is the "sunny-16" rule. With this rule, you can find the proper exposure for a scene in direct sunlight without the aid of a meter. Simply set the lens aperture for f/16 and the shutter speed to the number nearest the reciprocal of your film speed. To take a photograph of a scene on a sunny day with Kodachrome 64, you would set your aperture at f/16 and your shutter speed to 1/60 second (or any equivalent combination, e.g., 1/125 at f/11, 1/250 at f/8, etc.). To estimate exposure on other than a sunny day, use the recommended settings on the data sheet packaged with your roll of film.

In addition to controlling the amount of light that can reach the film in a given time, the aperture also controls another important aspect of photography known as depth of field. Simply stated, depth of field is the

zone of focus in which everything in the photograph looks reasonably sharp. A wide aperture (f/2, for example) results in a shallow depth of field—that is, a sharp subject against a blurred background. Conversely, by using a smaller aperture like f/22, depth of field is enhanced. A nearby tree and a distant mountain could both be in focus. To determine how much depth of field you want in a photograph, you should employ the use of a device found on many SLR cameras, the preview button. When you are composing and focusing with an SLR, your lens is at its widest aperture. But by pressing the preview button, you stop the lens down to whatever aperture is set on the lens. This way you can actually see how far the depth of field extends and can choose the best aperture for that subject.

The quality of the light striking your subject can be the deciding factor between having an average snapshot or a great photograph. The worst time to be out shooting is the middle of a sunny day. At this time, the sun is directly overhead, washing out colors and creating dark, featureless shadows. On such days, try to be out early or late in the day when the sun is lower in the sky, imparting form to your subjects. Some subjects, notably wildflowers, look best under a bright, overcast sky when shadows are reduced and colors enhanced. Stormy or low-light conditions can result in some of your best photos.

Even a great subject under excellent light can result in a mediocre photograph if the composition is poor. Good composition is easy to learn and is a must for good photography. All you need to do is follow a few simple rules. The first has to do with a condition known as "horizontalitis." Many amateur photographers take all of their photos with the camera held horizontally. This results in monotony for the viewer and does an injustice to many subjects. A rule of thumb to cure horizontalitis is to shoot primarily horizontal subjects (landscapes, cars, elk, etc.) horizontally and vertical subjects (trees, portraits, etc.) vertically. Simple, right?

Another important rule is the "rule of thirds." Photographs are usually more appealing if the subject is not directly centered. Imagine a tic-tac-toe board in your viewfinder and try to arrange the main subject in your photo at one of the four points where the lines meet. By doing this, you make the viewer's eye move throughout the photograph after first seeing the center of interest. Next, move in close or change to a longer lens so you can crop out any unwanted background that might distract the viewer. With wildlife or people, arrange the composition so your subject does not appear to be headed out of the picture—give it some room to move. Last, if there is a horizon line in the scene, put it in either the upper or lower third of the frame or crop it out altogether.

With these few simple rules, you can give your photographs more visual appeal. Of course, rules were made to be broken—some great photographs have been made by breaking some or all of these rules. But for the most part, you will find that the best photos will result from following these guidelines.

The quality of light striking the subject is extremely important; on sunny days, the best times to be out are early morning and late afternoon. Note the light reflecting from this Canada jay's eye, indicating that the sun was at a low angle and not overhead.

Now that you know how to take great photographs, where do you go to find great subjects? The answer can be found in your own backyard. We in the West, and particularly here in Montana, have a wealth of subjects at our disposal. Great scenics can be found throughout the state. Wildflowers abound in every habitat from prairie to mountain tundra. For bird and mammal photography, the best places to go are the numerous national parks and wildlife refuges in the state. Here, because little or no hunting is allowed, wildlife is generally more approachable. The best times to visit these areas are in the spring when the first new shoots are appearing and thousands of migrating birds are returning to their northern breeding grounds, or in the fall when blazing colors are at their peak, southbound migrants are on the move, and big game species are rutting. But any time you can get outdoors is a good time for photography.

With the great abundance of subjects from which to choose, how do you decide what to photograph, when to photograph it, and how? This is where the most important part of any type of photograph comes into play. It is called "the art of seeing"—where you visualize the final image in your mind even before you look through the viewfinder. It involves finding a good subject in an interesting position under adequate light, and knowing how to use your camera to capture the essence of that scene on film. It is the blending of all these elements that makes a truly great photograph.

But how do you learn to "see"? Start by viewing as many quality photographs as possible at art fairs and galleries, and in magazines like *Montana Outdoors*. Look closely at the photos and see if you can determine what it is that makes a great photograph so exceptional and a mediocre photo only mediocre. Then go into the outdoors and really look at the world around you. Look up in the trees and down at the ground. Get down on your hands and knees. You will be surprised at the worlds that will open before your eyes. Then use your camera to record your newfound world on film, and share that world with others. ■

CONTRIBUTORS

Some "otter viewers" describe the sight of this elusive furbearer with joy and awe. As **Hugh Zackheim** asks, "Why do we place such a high value on an animal that few of us know much about and fewer ever see?" Part of the answer lies in the article's title: "Lords of the River" (page 2). The other part lies in the playful, fun-loving appeal of the otter. Zackheim is an associate resource scientist for the Environmental Quality Council. From 1980-82, he studied river otters in southwestern Montana.

Karen Ray Brower of Butte prepared the inside front cover watercolor of river otters especially for this issue. Her attention to detail and accuracy reflect her academic training: She holds bachelor's and master's degrees in biology. Brower has lived in Butte for three years, and previously worked and exhibited her art in Bolivia and South Africa. Her work has won awards in three Montana shows, and it can be seen at the Robin's Nest, Butte; Tatem House, Helena; Wishing Tree, Livingston; and Orvis Wild Wings, Bozeman. Her studio is also her home and her work can be seen by appointment: 10 Cedar Lake Drive; Butte, MT 59701 (406/494-4179).

Region 1 (Kalispell) Parks Manager **Terry Knupp** has contributed two pieces to this issue. In "Scenery and Solitude Close to Town," beginning on page 6, she traces the history of Lone Pine State Park near Kalispell, emphasizing some of the recent improvements, including an interpretive trail and a visitor center. In "Bivouac," which leads off "The Catchall" section on page 11, she relates a personal hiking experience which could have turned into a real disaster.

Gas bubble disease—a problem caused by excess nitrogen dissolved in the water—is the biggest problem facing the Bighorn River fishery today. As **Wade Fredenberg** notes, 72% of the brown trout examined in a 1981 electrofishing sample showed symptoms of the disease. For a look at "Gas Bubbles on the Bighorn: A Deadly Mystery," turn to Fredenberg's article on page 8. He is a department fisheries biologist in Billings.

In Montana, opportunities for "Capturing Nature With a Camera" abound. Beginning on page 15, **Keith Szafranski** provides some down-to-earth tips: selecting a camera that fits your needs and pocketbook, choosing lenses for various photographic needs, what kind of film editors prefer, aperture and f/stop, and much more. A full-time free-lance photographer residing in Livingston, his work has appeared in our pages several times in the past. Proof that his tips work is found on our front cover.

When you think of a sucker, you *don't* think of a fish good to eat. Yet **George Holton** calls its flavor "distinctive" and "delicate"; he decided the problem was not with the fish, but with its unsavory name. Montana suckers are tough, adaptable fishes that are survivors. To learn more about "Montana Suckers: Aquatic Vacuum Cleaners," turn to page 20. Holton is the assistant administrator of the department's Fisheries Division.

Montanans and their guests literally have a world of water-based recreational opportunities to enjoy. But as enjoyable as these waters can be, they also can be deadly: Between 6,000 and 7,000 Americans die each year pursuing water-related activities. As **Bob Miller** writes, "...most people...probably could learn more about basic water safety and the factors responsible for water-related deaths...." "Water Safety: It All Depends on You" begins on page 24 and includes a sidebar on "Drownproofing Your Family—10 Steps to Survival." Miller is the safety administrative officer in the department's Conservation Education Division.

"Hundreds of thousands of tipi rings—small, circular alignments of stones that once anchored skin-covered tipis—still dot many Montana landscapes." These rings are one of the pathways into Montana's prehistory. In "Tipi Rings: Circles of Stone," **Les Davis** brings this engaging part of Montana's past to life. He is professor of anthropology in the Department of Sociology at Montana State University where he has taught and worked in archaeological research for 16 years. He recently retired as editor of *Archaeology in Montana* and serves as an associate curator of anthropology and archaeology for the Museum of the Rockies. Turn to his article on page 27.

Pat Barnes continues our "Perspectives" section with "The Warden and the Poacher" (page 32). It's a story about a time—not that long ago, really—when every man was his own law, especially in "fish 'n' game" matters. It's a story in which the warden and the poacher maneuvered to a draw, and an outsider emerged the winner. Barnes, a retired teacher, lives in Helena. In addition to teaching, he worked for the Forest Service in the summers, guided fishermen out of West Yellowstone, and operated a tackle shop and guide service. He still maintains his outfitter's license. Since retiring, he has traveled to India, England, Ireland, Tasmania, and New Zealand in search of trout-fishing adventures.

Illustration for "Perspectives" was especially prepared by **Diane Nugent**, Butte. She has done commercial art and fashion illustration, and currently works as a free-lance commercial artist in Butte. She has entered shows with her watercolors, pen and inks, and combination pressed flowers and watercolors. Her work is available through the Robin's Nest and Arts Chateau, Butte; Copper Village, Anaconda; and the Tatem House, Helena.

Montana is well-known as a state with clean, clear mountain water. But almost every year, at least one pollution-caused fish kill occurs. In fact, during 1983-84, 23 fish kills in natural waters were reported to the Department of Fish, Wildlife and Parks. **Glenn Phillips** tells you what to do "If You See a Fish Kill..." (page 34). He is the department's pollution control biologist.

Rich Stevenson's first appearance in *Montana Outdoors* has three colorful components: the watercolor of male mountain suckers in breeding colors (to illustrate the "suckers" article), "The Upper Hand," depicting the gratification of a fly fisherman's dream (to illustrate the "fish kill" article), and the back cover, "Freedom Earned," which brings to life the exploding escape of a rainbow trout. Raised in Montana and now residing in Livingston, Stevenson has always been an avid outdoorsman. It's not surprising that his interest should lead to a master's degree in wildlife biology, with a thesis based on field research on the Bighorn River. He worked as a fisheries biologist for the department in southwestern Montana from 1975-80, leaving to pursue a full-time art career. His work has been accepted for the C.M. Russell Show and Auction, the National Trout Unlimited Auction, the Wild Wings Sporting Collection Catalogue, and other shows and auctions. For information about his work, contact him at 914 W. Clark; Livingston, MT 59047 (406/222-0341).

MO would like to thank the following photographers whose work appeared in this issue: **Michael H. Francis** and **Ron Shade**, both of Yellowstone National Park, Wyo.

Montana Suckers: AQUATIC VACUUM

Male mountain suckers in breeding colors.

by George Holton
illustrated by Rich Stevenson

"Oh give me a home where the buffalo roam...." This opening line to "Home on the Range" was written in 1873. Now, 112 years later, only a remnant of these buffalo remain, but tens of thousands of unsung buffalo roam eastern Montana as they did a century ago. These buffalo, the bigmouth and smallmouth, are fishes—members of the sucker family. They have a hump-shouldered look; hence, the name "buffalo."

Montana has nine species of suckers, all native and among the most numerous fishes in the state. Their habitats range from our largest lowland reservoirs and rivers to mountain lakes and swiftly flowing streams.

Montana suckers are tough, adaptable, successful fishes that survive—indeed, some thrive—despite the introduction of non-native fishes and man's changes to their watery environment. Ecological success is to be admired, if begrudgingly. Yet, after the carp, they are our most maligned fishes. Even the name sucker denotes gullibility, an easy mark, and scorn: "poor sucker"; "there's a sucker born every minute"; "never give a sucker an even break."

The sucker-type mouth—stubby, underslung, toothless, and thick-lipped—is the sucker's hallmark, the basis for its name, and its place in nature. The name stimulates visions of disgusting feeding habits—sucking up muck and debris from the bottom, eating off the floor, so to speak. Most suckers can protrude their mouths for vacuuming food from plants, logs, rocks, and bottom muds. But all are rather selective in gathering their fare of plant materials and a variety of small animals such as snails, clams, worms, insect larvae, and water fleas.

Sport fishermen don't like suckers because of perceived harm to game fish populations. However, we really don't fully understand the ecological relationship between suckers and other fishes.

We do know that suckers up to eight or even 12 inches long are forage for walleye and northern pike, although walleye seem to prefer small yellow perch. Perhaps this is because the perch are more available in walleye habitats, or perhaps it's because suckers are better able to avoid capture, or that they grow quickly and are soon too large to serve as prey. Northern pike avidly consume suckers, as they do every other living creature available to them.

Under natural conditions, suckers coexist harmoniously with other fishes. Animal communities have evolved over the centuries much as individual species have evolved, and fishes have become adapted to each other, efficiently dividing the available resources, each with its own niche or role.

Before humans began restructuring fish populations by introducing new fishes and altering aquatic habitats, Montana trout streams typically harbored fish communities with few species. A cold water stream east of the Continental Divide might have

CLEANERS

contained cutthroat trout, mountain whitefish, mountain sucker, longnose sucker, longnose dace, Arctic grayling, mottled sculpin, and, when on spawning runs, white sucker. Trout streams west of the Divide similarly contained few kinds of fishes compared with warm water streams.

Most of the trout that now swim in Montana's waters—brown, rainbow, and brook—were introduced to the state and thus were not members of the original communities (there are a few native rainbow trout in the Kootenai River drainage—see *Montana Outdoors*, Jan./Feb. 1980). Brown trout came from Europe, where suckers are not native. Nevertheless, in his book, "The Compleat Brown Trout," Cecil E. Heacox writes, apparently based on his observations: "The common sucker, abundant in many trout streams, gets along well with the brown and causes no problems for fishermen." Brook and rainbow trout also should interact successfully with suckers because they have evolved with them in other areas of North America.

Suckers have been accused of preying on trout eggs. Trout protect their eggs by burying them several inches to a foot deep in gravel, depending on spawner size. Some eggs are lost downstream during the spawning process, but these are doomed anyway and eagerly sought by suckers and other fishes. Trout probably eat most of them. This taste for their own eggs is one reason trout can be readily caught by fishermen using trout eggs for bait.

Although suckers and trout compete for food, this does not appear to be a problem in undisturbed trout streams. Studies of trout behavior indicate the foraging sites they select are more likely to limit their numbers than availability of food. Even if there are situations where suckers compete with trout for food, the value of small suckers as trout forage might outweigh all adverse effects. In some waters, suckers may serve as an important link in the food chain from simple plants and minute animals to trout. Trout grow much faster once they start preying on fish.

Suckers are probably most limiting to trout in disturbed habitats, particularly in man-made reservoirs with fluctuating water levels. Here conditions become less than optimum for trout but are still favorable or even may improve for suckers. White suckers and to a lesser extent longnose suckers become the animal equivalent of weeds. Their reproductive potential is vastly greater than that of trout. A female white sucker usually lays 20,000 to 50,000 eggs, depending on her size; a rainbow trout lays only 400 to 3,000 eggs. Suckers successfully spawn in reservoirs; trout usually cannot.

In many reservoirs, suckers are the most abundant fish, outweighing all other species combined. Trout inhabiting these waters grow slowly. Here suckers must be controlled if good trout fishing is to be maintained. Although trapping is one means of control, it is successful only in those few places where the main sucker spawning run is vulnerable. Treating waters with biodegradable rotenone-based fish toxicants is the most commonly used method for controlling suckers. This is in a way comparable to plowing a field; if the operation is successful, all fishes—game and nongame—are killed. Cost limits the size of the water body that can be treated. After treatment, small trout are planted and grow well. However, there is almost always a canal or inlet stream that again seeds the reservoir with suckers and other nongame fishes. So in three years or so these populations rebuild to the point where trout growth is again retarded.

Since suckers are in good supply, why don't we make more use of them? The answer probably lies in the fact that we Montanans are sport fishing elitists. We seek the predatory fishes—trout, walleye, bass, etc.—rather than bottom browsers, such as suckers. The emphasis in fishing is on sport. Sport fish strike imitation minnows and flies much as they do real minnows and flies. They are most esteemed if they fight well when hooked, with much jumping and thrashing.

If you want to catch suckers, fishing with bait is the usual method. Some are spirited fighters, but leaping is not their forte. Montana fishing regulations also permit them to be taken, with few restrictions, by bow and arrow, snagging, and underwater spearing. Yet, Montanans harvest few suckers; they comprise less than 2% of the fish entered in fisherman logs (diaries cooperating fishermen keep for the Department of Fish, Wildlife and Parks). Most fishermen consider them "trash" or "rough" fish not worthy of being recorded. I'd guess that most suckers taken home are fed to the family cat or used to fertilize the garden.

In some parts of the country, suckers are held in higher esteem. I learned this rather abruptly on my first job. After finishing at Montana State University (Montana State College in those days), I went to West Virginia as a fisheries researcher. Our

crew was to study the relationship between suckers, other fishes, and smallmouth bass. One phase was to remove the suckers from a stream to see if this would improve bass production.

The local people went along with our study, but in spite of what our boss in Charleston (on the other side of the state) and our crew thought, many people in West Virginia's eastern panhandle didn't want all the suckers eliminated. In winter, they snared the white sucker (also found in Montana) through holes in ice-covered rivers. On spring nights, carrying gas lanterns, they waded streams and gigged migrating suckers with two- and three-pronged spears. Once I was even asked when we were going to plant suckers. West Virginia's mountaineers remain close to nature. Like the Indians before them, many recognize suckers as an available, palatable food, particularly good when taken from cold water.

Several regional books about fish give enthusiastic, if guarded, recommendations for suckers as food fishes. River carpsucker: "...reported to be excellent when smoked." Blue sucker: "...highly valued as a food fish." Smallmouth buffalo: "...flesh is firm and has a good flavor." Longnose sucker: "...flesh is firm, white, flaky, and sweet."

If one gets past the initial prejudice against suckers, the next problem is bones. Suckers are *very* bony. In addition to the head bones, backbone, ribs, and fin bones common to most fishes, suckers (as well as minnows, pikes, and some other kinds of fishes) have bristlelike, Y-shaped, "splint bones" lying between muscle segments along each side of the body. They may be an inch or so long in an eating-sized sucker, and serve as accessory ribs. Filleting doesn't get rid of them. Just as chicken bones must be contended with, special provisions must be made for bones when eating suckers.

In preparing to write this article, I persuaded my patient wife to cook a white sucker. To overcome the splint bones, she put the frozen filets through a meat grinder. Then she made patties, added crushed potato chips, egg, chopped onion, and steak sauce, and fried them. We liked their distinctive, delicate flavor and decid-

continued on page 26

MONTANA'S FOUR TYPES OF SUCKERS (Lengths are typical adult lengths)

Large, slender sucker with long dorsal fin. In Missouri and Yellowstone river drainages. Found in deep water of large rivers and reservoirs. Prefers swift currents.

Blue sucker (*Cycleptus elongatus*)[1] 28 inches

Large, deep-bodied suckers with long dorsal fin. In Missouri and Yellowstone river drainages. Inhabit lowland streams, rivers, and reservoirs.

Smallmouth buffalo (*Ictiobus bubalus*)[1] 23 inches
Bigmouth buffalo (*Ictiobus cyprinellus*) 29 inches
River carpsucker (*Carpiodes carpio*) 16 inches

Typical suckers. Representatives in all major drainages. Occupy a wide range of habitats.

White sucker (*Catostomus commersoni*)[1] 13 inches
Longnose sucker (*Catostomus catostomus*) 13 inches
Largescale sucker (*Catostomus macrocheilus*) 14 inches
Shorthead redhorse (*Moxostoma macrolepidotum*) 16 inches

Small sucker with cartilaginous edge on each jaw for scraping algae from rocks. In Missouri and Yellowstone river drainages. Usually live in clear, cold streams.

Mountain sucker (*Catostomus platyrhynchus*)[1] 6 inches

[1]Photo credits: blue sucker and smallmouth buffalo, "Handbook of Fishes of Kansas," University of Kansas Museum of Natural History, Lawrence, Kansas. White sucker and mountain sucker, "Fishes of Montana," Big Sky Books, Montana State University, Bozeman, Montana.

READERS RESPOND

Photo Issue: A Little Extra Beauty

Your Jan./Feb. 1985 Special Photo Issue is superb. I suggest you double the subscription rate if need be and run a couple more issues like it every year. I am enclosing two gift subscriptions. If you have any of the Jan./Feb. issues left, I would sure appreciate another copy for myself—and one for each of the gift recipients, to start them out with a little extra beauty.—*Cliff Benjamin; Shelby, Mont.*

* * * * *

You have done it again—made me homesick for Montana. I was born and raised near Ledger.

Please send me two more copies of the Jan./Feb. photo issue. I want to give them to people who appreciate wildlife outside of zoos.—*James R. Emrick; Spring Valley, Calif.*

* * * * *

I got your last photo issue that had poems. I liked not only photos but the poems. Here, I sent you one.—*Joshua Pomeroy; Troy, Mont.*

PLANTS

All summer long they put out their
blossoms to wilt,
During the fall they put out their seeds.

Then something unknown to flowers,
Captures and kills all,
Soon comes spring and overtakes winter.

Spring takes over,
Those seeds from fall
Magically turn to flowers.

It keeps rotating,
But never dies.

St. Paul Confusion

It was a treat to read Mike Gurnett's absorbing story about Sluice Boxes State Monument (March/April 1985), one of Montana's lesser known scenic and historic attractions. But when I read that James Hill was "a Minneapolis railroad magnate," this transplanted St. Paulite was reminded again how often my home town is confused with and upstaged by its sibling across the Mississippi River.

James Jerome Hill, originally from Ontario, Canada, married St. Paul waitress Mary Mehegan after sending her off to school in Milwaukee on "a large tip." Then Jim and Mary settled down in a modest little mansion on St. Paul's swanky Summit Avenue. The corporate headquarters and eastern terminus of Hill's Great Northern Railroad and its forerunner—the St. Paul, Minneapolis, and Manitoba Railroad—were also located in St. Paul.

One can be excused for confusing twins; they're often tough to tell apart. But these twins are not identical! St. Paul, with its ethnic neighborhoods, cultural traditions, gracious Old World dignity, and Irish Catholic politics, has been described as "the Boston of the Midwest." Minneapolis is a twin only by quirk of proximity. This upstart and homogenized burg has been compared more appropriately to cities like Great Falls ("Little Minneapolis on the MO," *Montana Magazine*, Sept./Oct. 1984); both have extensive park systems, foundings based on hydropower, and economies tied to agriculture.

Humorist Garrison Keillor best summarized the contrast between these two cities when he said, "The difference between St. Paul and Minneapolis is the difference between pumpernickel and Wonder Bread."—*Loren Bahls; Helena, Mont.*

"Elk Poker" Hits the Spot

First, let me say that *Montana Outdoors* can't be beat for the best photos and stories. I really enjoy it and look forward to receiving my copy; incidentally, I've been a subscriber for several years now.

Although I read it from cover to cover and enjoyed the Sept./Oct. 1984 issue very much, I must say that feature story by Bob Jensen, "Elk Poker," illustrated by Diane Nugent, really hit the spot. It was novel, and the truth was never in doubt—it hit the nail right on the head.

My congratulations to these people, and my hat's off to you for putting out a great magazine.—*Nevin D. Bean; Palmyra, Penn.*

Harlequins, Bluebirds

Two items in the fine March/April 1985 issue of *Montana Outdoors* moved me to report a couple of incidents.

On Aug. 16, 1968, I saw my first and only harlequin duck sitting on a rock above the Virginia Cascades in the Firehole River. I spent six full summers in Yellowstone and fished the surrounding area, but this was the only harlequin I ever saw.

At this time, Mr. and Mrs. Tom Nesbitt lived at the foot of Targhee Pass, eight miles west of West Yellowstone. A western bluebird built a nest in Mrs. Nesbitt's car; in spite of her using the car regularly—sometimes including a day-long trip—the birds successfully hatched and raised a brood of young there. We all thought it remarkable that they could succeed, but they did, as either of them could verify.

Yours is a delightful magazine. Like so many other good things in my life, it is a gift from the Nesbitts.—*John D. Black, professor emeritus, zoology, Northeast Missouri State University; Kirksville, Mo.*

Sixth Grade Big Fork Poet

Jim Wilson would like to submit some poems to be considered for publication in your magazine. He is in the sixth grade at Big Fork Grade School.—*Pat Darling, counselor, Big Fork Grade School; Big Fork, Mont.*

FRIENDSHIP

There's nothing like a friend to me,
Like a fish's friend is the sea.

I have friends at school and at home.
I have friends wherever I roam.

The nicest thing about friends, you see,
They are always willing to play with me.

So, if you ever have problems with a
friend,
Just be nice and you will turn out on top
at the end.

FEELINGS

Feelings come in every person, large or
small,
They come in every season even Spring
and Fall.

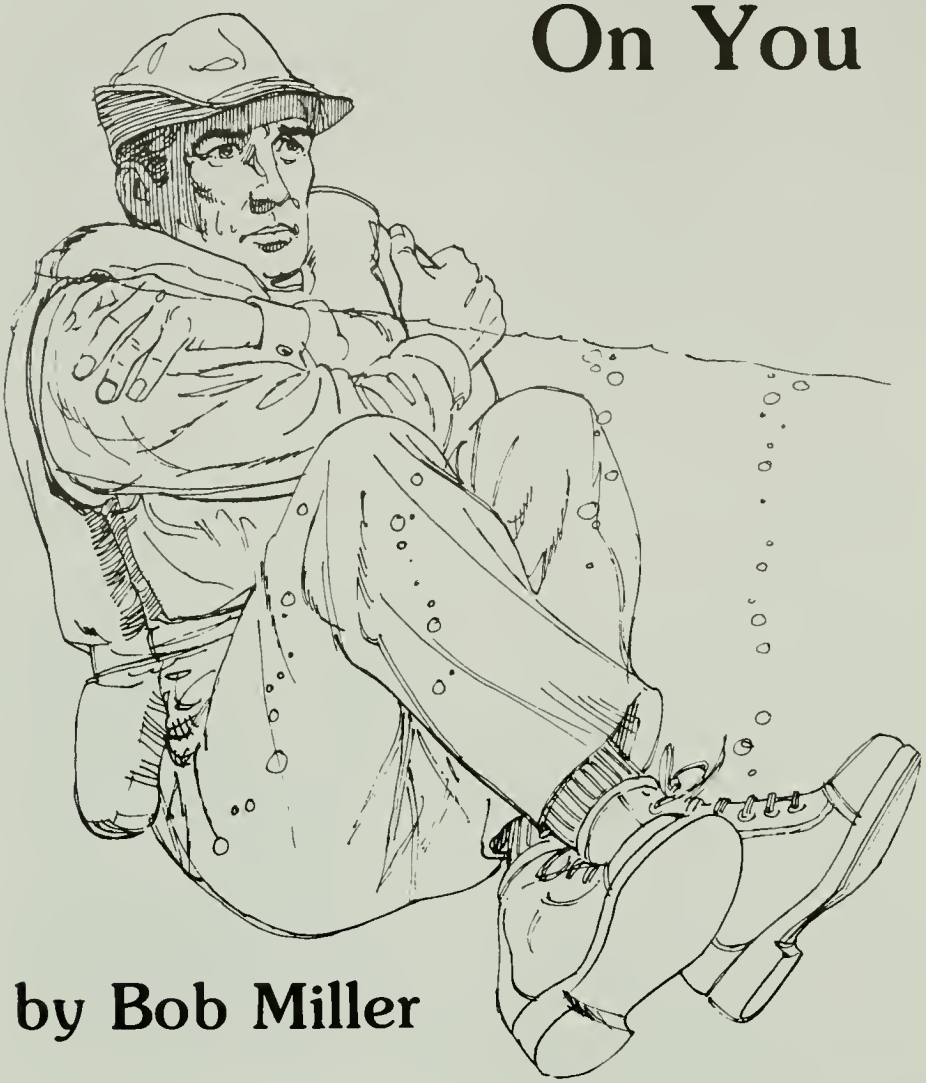
They come in many different kinds,
Like what you feel on Valentine's.

Some are mad, some are bad,
Some are just completely sad.

The feelings I like best of all,
Are happy feelings, even though I'm
small.

—*Jim Wilson*

WATER SAFETY: It All Depends On You



by Bob Miller

Whether sailing on Flathead Lake, plying a canoe through the wild and scenic section of the Missouri River, or drifting a fly over a deep hole on the Madison, Montanans and their guests literally have a world of water-based recreational opportunities to enjoy.

Yet, as enjoyable as these waters can be, they also can be deadly.

Consider the facts: (1) Between 6,000 and 7,000 Americans die each year pursuing water-related activities. (2) Drowning continues to be classified as the second leading cause of accidental death for those under 44 (only motor vehicle accidents rate higher), and the third cause of accidental death for all ages. (3) Drowning is especially tragic because it primarily affects the young. (4) An appreciable percentage of drowning's eventual victims (those dying from secondary causes) are usually not included in mortality-due-to-drowning totals.

If facts can speak for themselves, then perhaps we in the safety profession needn't say more. Yet we feel we must, because even though the national drowning toll has been decreasing over the last few years, much more can and should be done to prevent drownings. We also believe we must because most people, especially fishermen, small boat users, duck hunters, swimmers, and those who work around water, probably could learn more about basic water safety and the factors responsible for water-related deaths.

As unpleasant as they may seem, several statistics concerning drowning may lead to a greater understanding of this particular cause of death and suggest ways for recreationists to keep themselves from becoming statistics:

(1) Two of three drowning victims cannot swim.

(2) Two of three victims have no intention of entering deep water and do so fully clothed.

(3) One of every two water-related deaths occurs outside the normal swimming/boating season.

(4) Only one of every 10 drownings occurs in a guarded, supervised setting.

(5) Most drownings occur 10 to 30 feet from safety.

(6) Cold water—or more precisely, water that is relatively cold to the victim—is an important element in many drownings.

(7) Drowning individuals rarely call for help.

(8) Boating accidents account for 20% of all water-related deaths, most of which are due to drowning.

Researchers have found that in almost all drownings, one or a combination of three factors—inability to swim, cold water, and alcohol—has played a part. Fortunately, much is being done to lessen the chances of these factors increasing the drowning toll. All efforts center on education.

Teaching people to swim—to feel confident, capable, and relaxed in the water—probably saves the lives of more potential drowning victims than any other preventive measure. Physiologists have found that people who are relaxed float better and higher in the water than people who are tense and excited. The displacement of water caused by the muscle contractions and irregular breathing of an excited person is thought to be the primary reason. Further, capable swimmers, because they know they are not in imminent danger, can often "think" themselves out of a threatening situation when non-swimmers cannot. Thus, if you don't know how to swim—learn. You're never too old to do so, and it's much easier than you may think.

Convincing people to wear a Coast Guard-approved personal flotation device (PFD), more commonly called a "life preserver" or "life jacket," also is a universally accepted way to prevent drowning. Particularly for young children, older persons, those who are out of shape, or those who have never learned to swim, wearing a PFD is a must.

The reasons for wearing PFDs are well documented. Research has shown that children generally sink more rapidly than adults because they have less reserve air capacity in their lungs and because their bodies contain less fat and, thus, are less buoyant. Out-of-shape individuals, because they quickly become exhausted when struggling in water, have less chance to survive an unexpected immersion than

their fitter counterparts.

Research also has shown that the threat of drowning is greatly increased after alcoholic beverages have been consumed. Although most people know that alcohol in the blood interferes with performance, balance, and coordination, very few realize how serious the implications of mixing alcohol and water can be. Indeed, depending on a number of factors, such as age, drinking history, prior ability to swim, and water temperature, alcohol can markedly reduce the chances of an individual surviving a sudden plunge. Particularly in older non-swimmers, effects of alcohol can be tragic. Teaching more recreationists that alcohol and water don't mix in a recreational setting may do much to reduce the number of water-related deaths.

Stressing the ways that cold affects the human body and teaching in-water defenses against heat loss also have been and will continue to be effective ways to prevent water-related deaths. Each year, a number of deaths occur when people accidentally fall into cold water. Although the danger of cold water may seem most apparent during winter, the danger is actually more pronounced during spring when the air is warm but the water is still cold. Anyone who has tried to swim in a Montana lake on a balmy May day knows how cold the water can be!

Suddenly falling into cold water produces three bodily reactions. First, it propagates a sudden, involuntary gasp, as if you stepped into a cold shower. This "torso reflex" can be deadly if it occurs while the head is underwater. Second, it places a great deal of strain on the heart and circulatory system, which can be fatal in older, less physically fit, individuals. Third, it reduces muscle performance and stamina. In other words, a person suddenly immersed in cold water is at a decided disadvantage in fighting for his life.

Interestingly, the cause of death for victims who fall into cold water is often not drowning, but hypothermia—a rapid and drastic chilling of the body core. Researchers have found that without some type of body insulation, immersion in water less than 70°F, even for relatively short periods of time, can be fatal. When immersed in cold water, the human body loses heat more quickly than it can be replaced. When on land, an individual can often replace heat lost to the air through vigorous exercise or shivering. Many individuals erroneously assume that exercise will be equally beneficial in water. Unfortunately, this is not the case, since a large body of water can draw heat from an individual indefinitely. Exercise only acts to reduce the human body's store of energy and shortens survival time. In fact, one team of researchers found that remaining as motionless as possible when immersed in cold water can double the length of time an individual will survive—vigorous physical activity will cut that time in half.

Many individuals also assume that heavy, wet clothes are a burden and should be removed as quickly as possible or they will drag them to the bottom. However, nothing could be further from the truth. Most clothing helps the wearer float, because it traps air. In fact, the more clothing you wear, the better you will float. In cold water, particularly, clothing should not be removed because, in addition to aiding in flotation, it helps to retain body heat. Try to remember that clothing is not and should not be thought of as an appropriate substitute for a PFD, but that with a clear understanding of survival behavior, leaving clothes on could save your life.

Fishermen or waterfowl hunters who suddenly find themselves immersed in water above the tops of their waders should also keep this principle in mind. Removing waders is unnecessary; in such cases, removing them can sap a great deal of needed strength. Instead of trying to remove them, wearers should understand

DROWNPROOFING YOUR FAMILY
10 Steps to Survival

Water-related mishaps almost always occur at unexpected times and in unexpected places. Those who participate in activities around water should be aware of ways to help themselves and others if they should suddenly be faced with life-threatening situations.

One of the easiest and best ways to prepare yourself and family members for water-related emergencies is to practice survival techniques at a private or community pool. These "drownproofing" suggestions can be adapted to individuals, families, or larger groups:

Step 1: Since aquatic accidents mainly claim non-swimmers, use the pool to teach everyone in your family (including yourself) to swim. Learn to float, to relax, and to perform basic swimming strokes; take your time to learn, and practice what you learn in a non-threatening environment. Center your efforts on learning to float effortlessly on your back. This is the first defense a non-swimmer should master. By floating on your back, you save strength, keep your mouth and face out of the water, and reduce heat loss.

Step 2: Use the pool to develop swimming skills. All but the smallest pools can used to practice swimming strokes and kicks. Swimming laps in larger pools also helps to build endurance and confidence, while allowing the swimmer to learn his or her capabilities and limits.

Step 3: Use the pool to learn the hazards of shallow areas. An increasing number of injuries are being reported due to youngsters diving into shallow water. It's a good idea to allow no one, even children, to dive from poolside unless the water is as deep as they are tall.

Step 4: Use the pool to teach principles of water rescue and to emphasize that potential rescuers should never go into the water to aid someone unless no other life-saving measure is available. Practice extending an aid such as a broom handle or branch to someone in the water, and also practice tossing a rope to a distant swimmer.

Step 5: Use the pool to practice staying afloat while fully clothed. Remember that leaving your clothes on can help you float. Most people who drown are wearing clothes, but they don't know how to relax when fully clothed in the water or how to let the air trapped in their clothes assist them. So, learn how to float—first in shallow water, then in deeper water—with clothes on. When you learn that you can do so, you won't panic needlessly trying to remove them.

Step 6: Use the pool to practice falling into the water when fully clothed. Stand at the pool's edge and fall in backwards, covering your mouth and nose to combat "torso reflex" until you surface. Do so while wearing shoes or boots so you learn how they feel in the water and so you can recognize how they help you float.

Step 7: If you're a fisherman or hunter, use the pool to practice staying afloat while wearing waders or hip boots. In particular, chest waders are excellent flotation aids if you know what to do in them and have practiced floating in them in safe surroundings.

Step 8: Use the pool to teach everyone in your family to feel comfortable while wearing a personal flotation device (PFD). Learning to use life jackets, flotation cushions, ring buoys, etc. in safe conditions makes sense. A pool is an excellent place to learn that PFDs really do float.

Step 9: Use the pool to practice the **HELP** (**H**eat **E**scape **L**essening **P**osition). While wearing a PFD, cross your arms over your chest, cross your ankles, and pull your knees up to your chest. The primary concern is to keep your head up and out of the water.

Step 10: Use the pool to learn how to huddle with others in the water to prevent heat loss. One PFD is enough to support two huddling people as long as they relax and float motionlessly. By not moving and by tightly wrapping arms around each other's waists and forming a ring, you prevent heat loss, are more easily seen in open water, and can comfort each other in an emergency. Put small children in the warmer center of the circle.

By becoming familiar with the above suggestions and practicing them, you will all feel—and BE—a lot safer around the water. — *Bob Miller*

the benefits of leaving them on. As the air rushes out of the waders, very little air rushes in. Actually, they compress around the legs and lower torso of the wearer, thus remaining about neutrally buoyant. The effect is the same as with normal clothing—when the air is squeezed out, they neither sink nor float; they simply hang there, keeping the wearer warm.

So, should you suddenly find yourself unexpectedly in the water, think survival. Try to remain as motionless as possible; doing so will help to conserve needed energy and keep the air trapped in your clothes from rushing out. If you have to move to stay afloat, do so slowly and calmly while lying on your back. If you are wearing a PFD, try to assume the **HELP** position (**H**eat **E**scape **L**essening **P**osition) with your knees tucked into your chest and your arms clasped in front. The benefits of always wearing a PFD when recreating or working on or near water become quite obvious at such unexpected times. If two or more persons are in the water, huddling together also will act to conserve heat.

Now that the lazy days of summer are almost upon us, more and more recreationists will be returning to the waters that help make our state such a treasure. Those with little or no understanding of water safety and survival techniques will be faced with an ominous threat—the water itself—while those who keep water safety in mind will be able to enjoy all the pleasures water-based recreation offers.

Will yours be a safe summer? It all depends on you.■

Montana Suckers *continued*

ed the problem is not with the fish but with its unsavory name.

Another way to overcome the bones is by canning; this softens the bones as it does in canned salmon. Or you can score the filets: Lay them skin down and use a sharp knife to make a cut almost to the skin every 3/16 inch from head to tail. This fragmentizes the bones and lets cooking oils soften them so they cannot be detected. Suckers are also good smoked and in soups and chowders.

The booklet, "A Fine Kettle of Fish" (available from *Wisconsin Natural Resources Magazine*, P.O. Box 7185; Madison, WI 53707-7185, $1.95), tells how to catch suckers and other nongame fishes. It also suggests ways to prepare them, most sent "...by enthusiastic and unselfish cooks who wished to pass on to others their favorite mouth-watering recipes...." A sample of the practical advice offered: "How can you tell if the fish will have an 'off' taste? Sniff the gills. If they have a musty odor, the flesh will have it too."

In common with the flesh of other fishes, sucker meat is low in cholesterol and high in protein. Like venison, it isn't going to appeal to everyone. Yet, perhaps the same people who returned to energy basics in using wood for fuel will consider going back to food fishes that were important to Native Americans and helped sustain pioneers. If you are going to try suckers, as with any fish, be sure they are from clean, cold water so the flesh will be firm and palatable.

Abundant and widespread nationally, suckers are a largely unharvested food source. There is some utilization of suckers in Montana's limited commercial fishery. In 1984, a year when the market fluctuated, 32 tons of buffalo were harvested from Fort Peck Reservoir. In good years, 150 tons are taken. Montana buffalo are sold as food fish up and down the West Coast and occasionally in the Midwest. A ton or so of river carpsucker is also sold from time to time.

No doubt suckers would be better appreciated if there were more "fish-watchers," the aquatic counterpart of bird-watchers. Polarized sunglasses and clear water open wonderful new worlds to those seeking to understand how fishes live and interact. Their behavior is intriguing.

When spawning, several of Montana's suckers move up tributary streams or into the shallows of lakes where they are more readily seen. Some male suckers are handsome in their bright spawning colors. The mountain sucker has an orange or red strip on the side above a dark-greenish stripe that extends from snout to tail. The longnose sucker rivals the rainbow trout; breeding males often have a rosy strip on the side, plus reddish tones on the belly and lower fins. In some waters, the red is lacking, but even here the fish is striking, for the upper half is almost jet black with an abrupt change to the white underside. It resembles a miniature killer whale. The shorthead redhorse is also called the redfin, since year-round the tail and anal fin (unpaired fin behind the belly) are bright orange or blood red, and the other fins have reddish hues. The blue sucker is a large fish which is indeed blue or slate blue.

Suckers are even interesting in an aquarium. I kept a white sucker for a couple of years in a 100-gallon home tank. It sneaked in with some wild minnows I had planned to study. Although it became overwhelmingly large, it was a peaceful community fish that did janitor duty by siphoning up food the others missed. It became a pet. When offered food, it would come to the surface and eat from my fingers.

These maligned fishes have a place in the environment and perhaps on your table.

Suckers have evolved over millions of years and are firmly established in nature's scheme. They are not appealing like chipmunks or cottontails, but they deserve respect as part of Montana's natural heritage. Many fishermen would rather catch nothing than catch a sucker, and will disdainfully toss the fish on the bank to die. This is littering. Where fishermen concentrate, it becomes a problem due to the odor, unsightliness, and flies. It was once thought that anglers could improve sport fishing by killing every nongame fish they caught. However, there is no evidence that the sport catch of these fishes is effective in controlling their populations, and there is much reason to believe it has no effect.

So if you are not going to eat it, feed it to the cat, or plant it in the garden, why kill it? Toss it back. Perhaps a sucker deserves an even break.■

PHOTO COURTESY OF MUSEUM OF THE ROCKIES

MOMENTS IN MONTANA PREHISTORY

Tipi Rings: Circles of Stone

by Les Davis

Heavily laden dogs, paws torn and bleeding from the jagged limestone, growled and snapped at the harsh commands and blows. The larger dogs had already dragged 15-foot tipi poles for miles, while others struggled under bulky loads of bison skin lodge covers. Still a mile from their destination, the worn-out travelers reached the final steep limestone escarpment. There, the dogs' loads were taken up by boys and women who, thus encumbered, made their way carefully across the rattlesnake-infested sagebrush flats, up and over the juniper-dotted ridge, finally descending gratefully into the sheltered, resource-rich basin they knew as the Gray Oasis.

* * * * *

Hundreds of thousands of tipi rings—small, circular alignments of stones that once anchored skin-covered tipis—still dot many Montana landscapes. These durable circles of stone resulted from the use of tipis in communities established by prehistoric hunting and gathering peoples. Many western artists depict strikingly decorated tipis in lush, rolling grasslands or nestled serenely around forested glades and lakes in the Rockies. Tipi life itself evokes an image of a bygone time and place where early Native Americans pursued their lives free of outside encroachment. Some may even be reminded of summertime get-togethers and powwows on Montana Indian reservations. The tipi signifies a former way of life in the plains and mountains and, at the same time, symbolizes the struggle by Native Americans to preserve, sustain, and nourish traditional cultural practices.

Year-round use of tipis by prehistoric seminomadic peoples was common and widespread in the Great Plains from Alberta to Texas, throughout the middle and northern Rockies, and west into the valleys of Idaho—wherever bison ranged. Tipi rings vary from seven to 30 feet in diameter, averaging around 16 feet. Prehorse tipi rings, which required 10 or more prime cow bison skins, were up to 13 feet in diameter. Archaeological evidence suggests that although prehorse tipis, on the average, were smaller, some were as large as some constructed after introduction of the horse into Montana around A.D. 1720.

Tipi rings are the most obvious and numerous surviving prehistoric architectural features in Montana. These circles of stone mark the position of former households and encampments occupied and vacated at some time within at least the final 3,500 years of regional prehistory. Represented are short-term, seasonally occupied camps made and used by wandering foot nomads and those of later horse-mounted peoples; they were seeking food and other resources in the Rocky Mountains and plains.

Although they have been recognized as a product of human endeavor for a long time, tipi rings have not provided much information about the extinct lifestyles they represent. There has even been much discussion of how long ago they were used. An exasperated archaeologist once called tipi rings "manifestations of unknown relationship."

Nonetheless, tipi rings are easily the most numerous, widespread, and most often preserved tangible evidence of prehistoric architecture and settlement patterns in Montana. With few exceptions, knowledge about tipi rings as an important index to prehistoric settlement behavior has not advanced very far over the past 40 years. In that time, untold numbers of tipi rings have been destroyed, often without regulation and often on public lands in Montana.

During the past decade, compliance with cultural resource protection laws and agency regulations has stimulated only a few technically innovative, advanced studies of tipi ring sites threatened by federal and state land modification projects. One of the more productive tipi ring research projects was conducted west of Townsend, Mont., in an arid, rain-shadowed area of the Limestone Hills on the east slope of the Elkhorn Mountains. Scattered springs favor a few locations with sweet water year round in the Limestone Hills. One such spring watered a tipi ring site on state land leased by the Montana Army National Guard for two decades as a military training and maneuver area.

At the request of the Bureau of Land Management (the main property holder in the leased training area), the National Guard contracted for an archaeological survey of the Limestone Hills area with Montana State University in 1979. Researchers recorded several hundred prehistoric and historic sites in the 24,000-acre study area. One of the most interesting discoveries was the largest tipi ring encampment in the survey area, consisting of 70 tipi rings, several fire hearths, and a rock pile inside a 30-acre area. The Pilgrim site (named after the nearby Pilgrim limestone and dolomite outcrop) was still largely intact, but it was located inside the high-intensity bombardment area essential to the Army National Guard's mission. Because of anticipated damage, the site was partly excavated to preserve a permanent record of its archaeology. The tipi rings were destroyed in the process, and access to the area is restricted by the National Guard.

Radiocarbon dating of charcoal and bone excavated from inside tipi rings revealed that these particular lodges were occupied intermittently from about 1400 B.C. to A.D. 1450. Peoples of three distinct archaeological complexes—Pelican Lake (1500 B.C. to A.D. 350), Avonlea (A.D. 100 to 1100), and Late Plains (A.D. 1100 to 1800)—had camped there. These Pilgrim site tipi rings had been constructed and occupied before introduction of the horse into that area of Montana. Discarded or lost flaked stone tools were recovered from 90% of the tipi rings excavated: 22 projectile points, 15 knives, 37 cutting and scraping tools, two hide-fleshing end scrapers, five heavy-duty hide-fleshing side scrapers, a stone bone chopper, eight cores from which flakes of desired size and shape had been removed, and more than 1,600 flakes. These implements typify the flaked stone tools used by hunter-gatherers of the Late Middle Prehistoric Period (1500 B.C. to A.D. 350) and the Late Prehistoric Period (A.D. 100 to 1800) who seasonally visited this remarkably resource-rich locality.

The kinds of stone used by those who visited Pilgrim explain in part why Stone Age peoples camped there

MSU PHOTO

Many tipi rings are partly imbedded in sod today, still in their original configuration and partly exposed above ground. An interior fire hearth near the center may indicate that this tipi was inhabited during stormy or unpleasant weather.

MSU PHOTO

A low-level aerial view of an Avonlea Complex tipi ring during excavation on the east side of the central drainage at the Pilgrim site.

over some 3,400 years. During the survey, researchers found several stone quarry and workshop sites, places where early peoples acquired and worked high-quality, glasslike stone such as quartzite and chert. More than half of all stone utilized at the Pilgrim site was obtained inside the Limestone Hills. Don Smith, project geologist, also identified obsidian, basalt, quartz crystal, chalcedony, and siltstone. Such stone had been carried to the site by groups of seminomadic people who carried small supplies of flakable stone and tools with them from place to place.

Fragmentary bones were recovered from 18 of the excavated tipi rings. Michael Wilson, project zooarchaeologist, identified them as those of bison, deer, possibly pronghorn, and a grouse-sized bird. All were hunted and eaten during stays at Pilgrim. Much of the original bone scrap was probably consumed by camp dogs or other scavengers.

Several circumstances caused researchers to wonder why different people visited this spot in the Limestone Hills, repeatedly, and over a long period of time. The reason obviously was not merely to bolster meat supplies, as evidenced by the small amount of surviving bone scrap; the small number of hunting tools (points), butchering tools (choppers and knives), and hide-working tools (end and side scrapers); and the small number of interior and exterior fire hearths. The year-round availability of potable water, woody plants for fuel, fragmented bedrock for anchoring tipis, accessible game herds and other animals, and shelter from wind did not satisfactorily account for the visits. Although those same vital natural factors were observed elsewhere in the Limestone Hills, tipi rings did not occur there, even where outcrops of quartzite and chert had been used nearby.

An explanation for the site's attractiveness came from an unexpected direction. Soils at the site were studied in connection with local geological work to try to understand past environments and resources that could have attracted prehistoric peoples. Bob Ottersberg, project soil scientist, found that the geology and soils differed dramatically from one side of the central drainage to the other. Moreover, certain edible plants growing on site (some of which were eaten by crew members during excavations) occurred only in particular soils.

After bitterroot (*Lewisia rediviva*) and wild parsley (*Musineon divaricatum*) were recognized by Steve Aaberg, project field supervisor, the modern plant life on the site was inventoried in detail. Of 75 plant species growing within site limits, a remarkable 60% were eaten or used for medicinal, ritual, or industrial purposes (such as dyes, cordage, and deodorants) by North American Indians. These plants, particularly the bitterroot and wild parsley, could have been gathered only in the spring. That is when these productive and nutritious plants were sought by gatherers at that location. Thirty-eight other plants also usable in spring—such as onion, puffball, Bee plant, yucca, cactus, wild rose, and currant—would have been additional attractions. Thus, periodic seasonal visits by early peoples to this diverse and productive area were made not for the purpose of obtaining game, but of gathering and processing roots. These gatherers were able to vary their diets while gathering roots, but were intent on supplementing their tiresome winter diet of dried meat.

Other evidence also supported that explanation. Root digging, cleaning, and drying would have required about two weeks. This meant the gatherers would have had to stay in the area in the often unstable, turbulent spring weather, until the roots were ready for storage in leather containers.

The presence of people at the site in the spring, as suggested by the age at death of a nestling bird (which the visitors had eaten) and by the short-term, seasonal availability of bitterroot and wild parsley, was confirmed again by the way that stones had been placed around the base of the tipis. The predominant weighting or loading of stones in the southwest quadrant of the tipi circle would have protected the lodges against toppling and destruction in the late spring storms and winds that invariably battered this narrow, intramountain valley.

The Pilgrim site may have been occupied for only a short time each year, as indicated by the limited amount of food scrap, stone tools, and waste left behind. Small groups of hunter-gatherers—extended family groups exploiting multiple food resources—wintered to the east in the Missouri River Valley. Bison, deer, pronghorns, wapiti, and other game wintered in the Limestone Hills, on the east slope of the Elkhorn Mountains, and in the valley. In late spring, hunters and their families left the valley—food supplies and body fat reserves exhausted, with worn-out footwear and clothing, and precari-

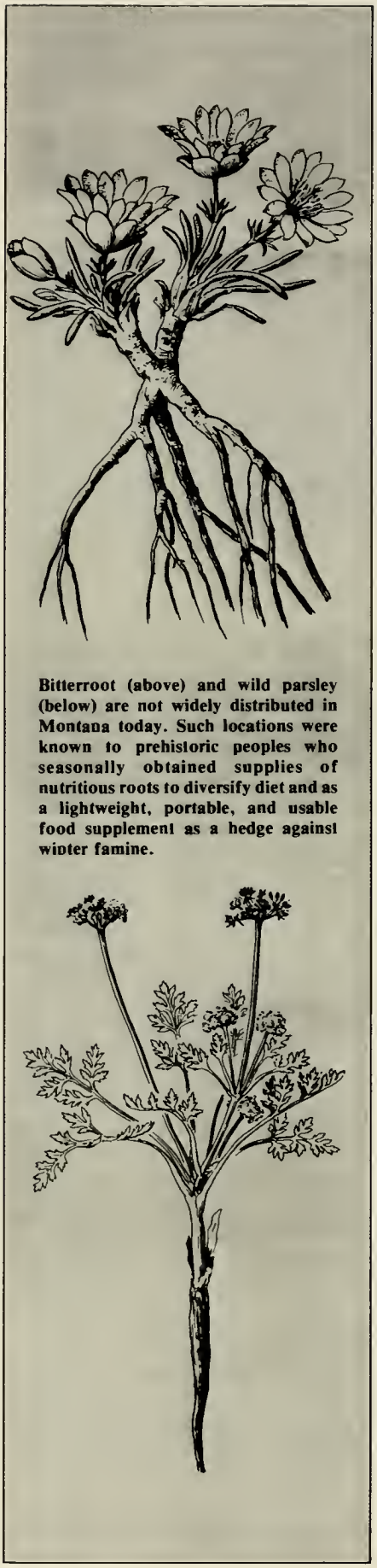
ously short of high-quality stone—and headed for the Limestone Hills. They loaded lodge poles, skin lodge covers, and household and personal baggage onto travois dragged by gaunt, harnessed dogs, and trekked westward.

Arriving eventually at the Pilgrim site known to them as the Gray Oasis, they first rested. After hunting and making a kill, they fed on fresh meat and restocked their supplies of quartzite and chert. Still later, with packages of light yet bulky dried roots loaded onto the travois, they moved southward toward lodgepole pine forests to replace broken and shortened lodge poles. Soon they moved to the grasslands to obtain prime cow bison hides, to be tanned and made into new clothing, footwear, and lodge covers.

Over several generations, the availability of a dense and stable population of nutritious root plants at the Pilgrim site would have become traditional lore. Their existence would have drawn people to this life-giving location seasonally. But how often did nomads on foot, using the portable tipi, actually move long distances, from one camp to the next?

The much-touted ease with which tipis could be constructed, set up, taken down, transported, and repaired may have been exaggerated. That assumption was founded largely on historic observations and impressions and later reinforced by experiences of modern-day occasional tipi dwellers. Such an impression may have been gained initially from men who actually had little to do with the lodges and household goods—such things were considered the property and sole responsibility of women. In truth, the skin tipi was a heavy, unwieldy, and entirely destructible dwelling. For peoples limited to movement on foot, with dogs as their only beast of burden, energy spent constructing, maintaining, and moving lodges would have been considerable. The selection and cutting of lodge poles, their trimming and seasoning, and the skinning of bison and the tanning and tailoring of cow skins required significant energy from women.

For example, 19 poles were ordinarily needed to support a 24-skin lodge: four main tipi poles, five secondary poles on each side, two near the door, one at back center, and two smokeflap-support poles out front. Such poles were 18 to 20 feet long and weighed about 20 pounds each, depending on their age. Because of their length and weight, the poles had to be dragged along the ground. The skin cover, lining, and pegs and pins could be carried easily by a single horse. However, the lodge cover must have sorely strained the load-pulling and load-carrying abilities of the dogs.



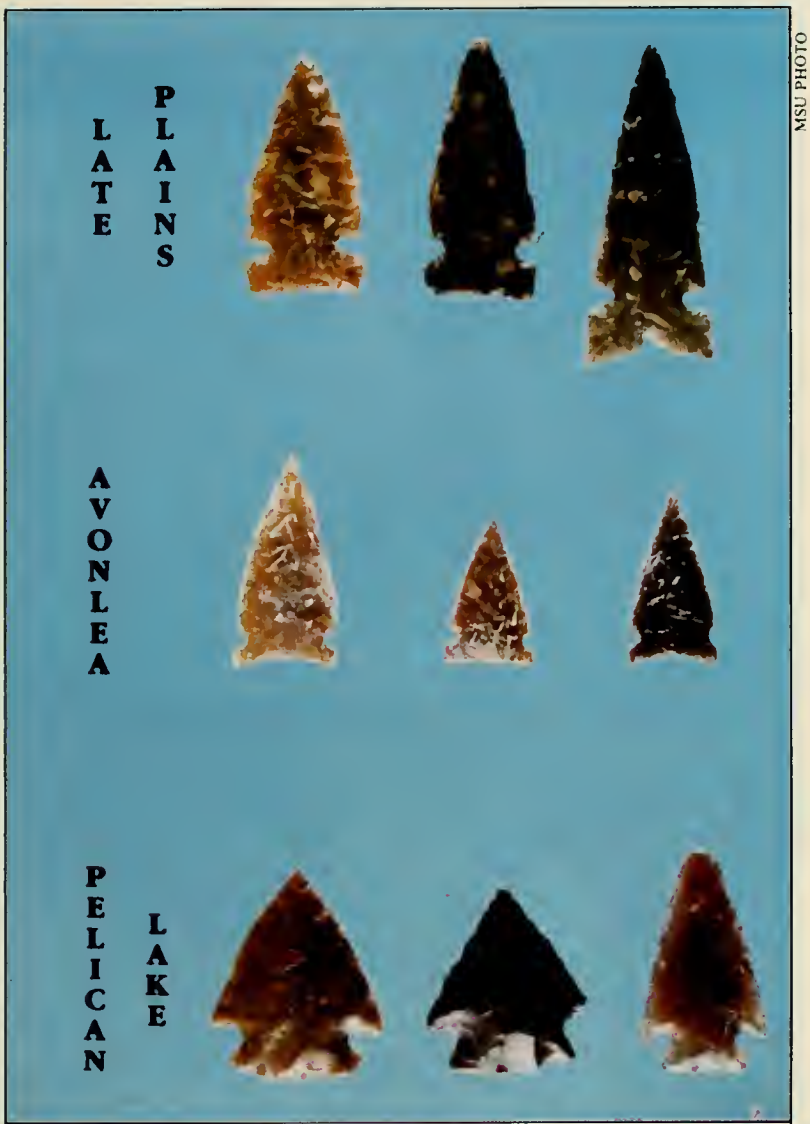
Bitterroot (above) and wild parsley (below) are not widely distributed in Montana today. Such locations were known to prehistoric peoples who seasonally obtained supplies of nutritious roots to diversify diet and as a lightweight, portable, and usable food supplement as a hedge against winter famine.

Certainly, the life span of any tipi was a function of the frequency of its being taken down, loaded, unpacked, and set up. Even while tipis were standing, lodge poles dried out and lodge covers already cracked and split became even more weatherbeaten, dried out, wore thin, and were gnawed or consumed by insects, rodents, and dogs. As lodge poles became shorter because of being dragged and broken, and the lodge cover deteriorated, some lodges actually became smaller in size and in interior living space.

While the tipi was admirably suited as a year-round portable shelter, its bulkiness, weight, and structure must have limited the frequency of camp moves, much more so before the advent of the horse. The accuracy of referring to some tipi ring sites as communities or settlements of long duration, rather than as short-term or ephemeral camps, may be closer to the truth than is generally believed.

Few tipi rings can be attributed to particular historic Indian groups. Some tipi rings represent use of tipis by people ancestral to historic Shoshones, since tri-notched obsidian arrow points, flat-bottomed hand-molded pottery, and soapstone vessels and pipes derived from the activities of proto-Shoshoneans. Cord-marked pottery found in some tipi rings in southern Montana may reflect occupation by populations ancestral to the Crow Indians. Tipi rings used by the Blackfeet, Cree-Chippewa, Gros Ventre, Assiniboine, Sioux, Northern Cheyenne, Flathead, Pend Oreille, and Kutenai cannot be distinguished from one another, partly because those groups began full-time residence in Montana so recently.

Tipis were used in the mountains and plains of Montana at least 3,500 years ago. However, additional



The form, size, manner of production, and mode of propulsion of projectile points excavated from radiocarbon-dated lodge floors at the Pilgrim site are useful time-culture markers that identify resident peoples.

research will probably extend that use further back in time. Some older tipi rings are buried from view, unknown, or inaccessible. The excavation of more than half of the tipi rings at the Pilgrim site led to development of significant insights into the cultural history of the site. Still more can be learned about these hallmark archaeological features.

Tipi ring sites that have survived into our own time at great odds serve as a key source of knowledge. A source of tangible information about now-extinct lifestyles in this part of the world, tipi rings merit public interest and appreciation. The more than 2,000 tipi ring sites recorded in cultural resource files at the University of Montana attest, in a minimal way, to the former abundance of these households and communities of Montana's earlier mobile home residents. By protecting, preserving, and carefully studying tipi rings, much more can be learned of these peoples who passed lightly through Montana landscapes.

* * * * *

Before taking the tipis down, the women lifted and set aside the stones they had earlier placed around the tipi base. They had placed the stones on top of the lodge cover, to secure the tipis against the wind. After removing the lodge cover and the tipi poles, the women returned to the worn, circular places where they had socialized and slept, the places sheltered and secured against the elements. They picked the stones up, one by one, and replaced them around the margin of each living floor, restoring the original shape and size of each lodge. That act marked, and would later commemorate, good times spent at this favored place. The spirits of the earth and sky would know of their intention to return and honor this place. ■

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The
and The

by Pat Barnes
illustrated by Diane Nugent

Dating back to the days in the West when every man was his own law and open range was the rule, there has been a built-in prejudice against higher authority encroaching on what westerners consider their rights and privileges. This has certainly been true where fish and game are concerned.

During my youth, the Fish and Game Department was small; the few game wardens it could afford to employ were often local men who had the same basic background and philosophy as the residents of their district. These wardens ruled their areas more or less with a free hand, dispensing justice within guidelines only loosely prescribed by headquarters. Those days, of course, are long gone, but out of them grew many stories of how the warden outsmarted the poacher, or vice versa, each in his own way practicing what might be called "one-upmanship." Only occasionally did outsiders get involved on the winning or losing side. But in the story that follows, you might say that the warden and the poacher maneuvered to a draw, and an outsider was on the winning side.

The year was 1922. Someone was shooting beaver on the lower stretches of the rivers forming the Missouri at Three Forks, Mont. There was little evidence of who was doing the shooting; no shots had been heard, and no tracks into or out of the river where dead and skinned beaver had been found had been reported by ranchers, fishermen, or other friends of the warden. No strange cars or even local ones had been seen near the vicinity of the beaver carcasses.

Warden Frank M., whose job, among other things, was to keep beaver alive for legitimate trappers, was worried. One dead beaver along one of the rivers wasn't much to worry about, but reports coming in from all three drainages indicated a serious problem. A smart poaching operation had to be stopped, even if it meant devoting full time to it.

It was obvious from the start that the culprit was floating the river at night, somehow locating his game for an easy shot, skinning the animal on

Warden Poacher

the spot, and floating on. Frank knew the country well. He realized that the closest place to get a boat in on the Jefferson River was at Willow Creek. On the Madison, the road came close to the river at a spot known locally as Black Point. On the Gallatin, one of the bridges crossing the river out of Belgrade toward Menard seemed a likely spot. Dead beaver had been found below all of these points, but none above. Frank reasoned that the take-out point could have been Logan or Three Forks, but more likely was farther downstream—probably Trident or even Lombard. Lombard at that time was a flag station on both the Milwaukee Road and the Northern Pacific, a stop that had two railroads going through it but no wagon road. Inquiries about these latter spots disclosed evidence that a so-called clothing salesman with heavy sample cases had boarded trains for Butte from them. This seemed to Frank to be the first real break in the case. More leg work was required. A week at Lombard, presumably to fish Sixteen Mile Creek, was the next order of business, with enjoyable evenings spent entertaining the stationmaster's daughter.

Regretfully, that came to an end. Trident was the last hope. With the recognizable Model T coupe parked out of sight and with fishing rod in hand, Frank wandered along the Missouri River headwaters looking for anything that might tie in with a possible take-out spot for a boat—a place not too far from the depot. Frank gave special attention to a "hobo jungle" camp used by men of the road. It was deserted most of the time, with only an occasional occupant. There were a few empty cans, two circles of rocks containing dead ashes, one orange crate, and several cottonwood logs dragged into place with broken limbs forming crude frameworks for shelter. Frank passed this spot several times before he noticed off to the side of the camp and near the river an old and rusty corrugated piece of roofing. It lay partly concealed by wild rose bushes and seemed not to have been disturbed for years. However, closer inspection revealed that it had been lifted recently.

Frank hooked a toe of his fishing boot under one end and flipped it over. There, neatly folded and wrapped, was a canvas boat with oars, a long object in an oilskin, and a rain slicker, which, when unwrapped, disclosed a cooking kit. The object wrapped in oilskin turned out to be a Winchester .25-20 rifle to which a home-made silencer had been screwed. A flashlight had been neatly assembled on top of the barrel with batteries positioned in the bored-out stock. It was an ideal gun for night shooting, which was (and is) highly illegal.

The warden quickly ran through the list of possibilities. Where was the poacher now? Would he come back for his equipment, and if so, how soon? Had the poacher's supply of beaver run out, making the operation no longer profitable? Should he continue the investigation with a stakeout? Considering the time he had spent in the vicinity, Frank doubted that his presence in Trident had gone unnoticed. He had been neglecting his other duties too long, so he decided to end it there. He burned the boat and oars, removed the flashlight from the gun, and had a gunsmith work over the threads on the end of the gun barrel.

Needless to say, the poacher, without his tools, either gave up poaching thanking his lucky stars he hadn't been caught, or moved on to greener and fresher pastures with new equipment. In any event, the beaver killing ended in Frank's territory. Years later, when Frank died, a young warden and I found, in the bottom of a trunk in the old warden's cabin, the rusty silencer.

Why do I consider the episode to have ended in a draw? The warden must have considered himself a winner. Why else did he keep that silencer, except as tangible proof of his one-upmanship? And the poacher? Although we know nothing of him, I can just hear him bragging to his friends, "I made a killing on beaver, right under the nose of one of the best wardens in the state."

I said earlier the only winner was an outsider—in this case, me. Warden Frank M.—Uncle Frank to me—had given me the poacher's rifle, the same gun that I used to kill my first elk when I was 15 years old. ■

If You See A Fish Kill . . .

by Glenn Phillips
illustrated by Rich Stevenson

Probably nothing does more to raise the hackles of Montana anglers than to hear that something is killing fish in one of their favorite trout streams—and rightly so. Montana's Constitution guarantees its citizens the right to a clean and healthful environment. Many Montanans have given up high-paying jobs in other parts of the country to be able to live within a stone's throw of Montana's blue ribbon trout streams: Trout are the reason they are here. Yet in spite of Montana's reputation as a state with clean, clear mountain water, almost every year at least one pollution-caused fish kill occurs.

The following paragraphs describe a typical chain of events associated with a fish kill, summarize fish kills in Montana over the last two years, attempt to answer some of the most common questions that the Department of Fish, Wildlife and Parks receives when a fish kill occurs, and suggest how citizens can help the department validate the cause of fish kills.

Clark Fork River—Aug. 1, 1984

It is nearly 10 p.m. Wayne Hadley, the department's fishery biologist in Deer Lodge, receives a phone call from the local warden. A fish kill has occurred in the Clark Fork River near Warm Springs. Hadley calls Helena where the Pollution Control Office is notified. (The Department of Fish, Wildlife and Parks maintains a Pollution Control Office that, among other things, coordinates fishery-related water quality problems with the Water Quality Bureau of the Department of Health and Environmental Sciences.) Hadley also informs the Anaconda Company (the kill appeared to originate on its property) and arranges to meet company representatives at the site of the kill the next morning. That same night, Helena personnel notify the Water Quality Bureau of the Department of Healty and Environmental Sciences (DHES) and the Environmental Management Division of the Department of Agriculture (DOA). Dick Pedersen, environmental specialist for the Water Quality Bureau, and Dick Blodnick, pesticide specialist with the DOA, are assigned to help out. Early the next morning, a vehicle loaded with the necessary sampling equipment leaves for Warm Springs. Another fish kill investigation is under way.

During the next two days, the specialists spend over 20 hours at the site. They walk miles of stream, take photographs, conduct interviews, and collect sediment, water, and fish samples. After all of the laboratory results were examined, their significant findings included:

(1) The kill was associated with a major thunderstorm. Since the entire area is interlaced with metals-rich mine tailings, metals were immediately suspected as the cause.

(2) The kill began near the Mill-Willow bypass (a channel that diverts water from Mill Creek and Willow Creek around the Warm Springs ponds and into the Clark Fork) and extended approximately 15 river miles downstream in the Clark Fork.

(3) Observers at the Mill-Willow bypass immediately after the thunderstorm noted the water turned reddish-tan during the storm (the red suggests the presence of iron hydroxide in the water). Observers also saw a fish floundering on the surface of the water during the storm; water levels dropped rapidly and cleared shortly afterward.

(4) Water samples taken in the Deer Lodge vicinity about one day after the kill (Deer Lodge is about one day flow travel time downstream) were turbid and contained higher concentrations of metals than samples collected the same day at the site of the kill.

(5) The Silver Bow Creek bypass channel at the head of the Warm Springs ponds appeared to have received water during the thunderstorm (when flows are high enough, Silver Bow Creek spills into the Mill-Willow

bypass and circumvents the ponds without treatment).

(6) Freshly deposited sediment taken from the edge of the Mill-Willow bypass contained extremely high concentrations of metal—37 parts per million (ppm) copper, 65 ppm zinc, 8 ppm lead, and 1 ppm cadmium. Similarly high metal concentrations were found in sediments from the Silver Bow Creek bypass—135 ppm copper, 93 ppm zinc, 8 ppm lead, and 1 ppm cadmium.

(7) Gill tissue from dead and dying fish contained nearly twice as much copper as is known to be lethal. Particulate material imbedded in the gills of dying fish was also rich in copper.

In the case of the Clark Fork, notification was prompt, and investigation began less than 24 hours after the kill was reported. Evidence was still fresh and proved beyond any reasonable doubt that copper washed into the stream during the thunderstorm caused the fish kill.

Unfortunately, early notification does not characterize all fish kills. Some kills go unnoticed because they happen in areas people rarely frequent. Delays also result when citizens fail to notify the Department of Fish, Wildlife and Parks when they first see a kill. For example, the department might receive a call on Monday morning from an angler who noticed dead fish in a creek the previous Wednesday. In some cases, several weeks might pass between observing and reporting. It is easy to understand how such delays occur, but the chances of determining the agent responsible for a given kill decrease with time. Evidence disappears rapidly and is usually all but gone in a few days. Citizens who see dead fish in a stream can aid fish kill investigation by notifying the Department of Fish, Wildlife and Parks as soon as possible.

Fish Kills: 1983-84

During the last two years, 23 fish kills (that occurred in natural waters) were reported to the Department of Fish, Wildlife and Parks (Table I). Four were reported to the department too late for adequate investigation. Sixteen occurred between early May and late August—not too surprising since use of chemicals and outdoors activities are at their peak. Further, higher water temperatures during summer increase the vulnerability of fish to most pollutants and fish diseases.

Eight were attributed to something other than man-caused water quality degradation. They were caused by fish diseases, problems with acclimation of hatchery fish, stream dewatering, or winter kill. Eleven of the kills were the result of some kind of man-caused pollution. Investigation of five produced evidence that clearly established the cause. Evidence ranged from the presence of known lethal concentrations of metals in gill tissue (Clark Fork and Boulder rivers) to witnesses who verified that aquatic herbicide had reached the stream (Racetrack and Muddy creeks). The other six investigations yielded circumstantial evidence that strongly suggested the cause of the kill, but failed to validate the cause; e.g., fish killed in the Bighorn River suffered lesions on gills characteristic of exposure to acrolein, an aquatic herbicide commonly used to prevent irrigation ditches from becoming choked with vegetation. Nevertheless, the investigation did not show with absolute certainty that acrolein had entered the river.

Five of the pollution-caused kills were categorized as major, involving more that 250 catchable trout (6 inches or longer). Two occurred in the upper Clark Fork River; the remainder were in the Bighorn River and Big Spring and Racetrack creeks. The 1984 episode in the upper Clark Fork probably killed more than 10,000 catchable brown trout.

Common Questions

With almost every fish kill, the Department of Fish, Wildlife and Parks is deluged with questions from reporters and the public. The attention received is certainly deserved, but most kills also generate their

share of misunderstanding. Some of the most common questions, and the department's answers to them, follow:

Q: What agencies have enforcement authority when it comes to fish kills? What means exist to prevent the same thing from happening again?

A: The two laws that come into play when a man-caused fish kill occurs are the Montana Water Quality Act and the Montana Pesticide Act. Civil penalties can be invoked under both: $10,000 per day under the Water Quality Act, and $1,000 per

Table 1--Fish Kills Reported to the Department of Fish, Wildlife and Parks (1983-84)

	Year, month	Location	Game species affected	Estimated mortalities	Cause
1983	June	Park Lake (near Clancy)	rainbow trout	50-100	Unverified; suspected problem with acclimation of stocked hatchery fish.
	June	Boulder River (near Boulder)	rainbow trout	less than 20	Unverified; metals originating from mine tailings suspected.
	July	Clark Fork River (near Galen)	brown trout, whitefish	500-1000	Unverified; metals originating from mine tailings suspected.
	July	Racetrack Creek (near Racetrack)	brown, brook trout	250	Acrolein leaking from an irrigation flume.
	August	Clark Fork River (near Alberton Gorge)	rainbow trout	-	Reported too late to allow adequate investigation.
	September	Big Spring Creek	rainbow trout, whitefish	1,000-1,500	Unverified; suspected discharge of anhydrous ammonia.
1984	January	private pond (near Evergreen)	nongame only	-	Winter kill.
	January	Cliff Lake (near Kalispell)	rainbow trout	500-1,000	Winter kill.
	January	Yellowstone River (near Billings)	nongame only	-	Unverified; industrial discharge suspected.
	February	Belt Creek (near Belt)	cutthroat trout, whitefish	100	Dewatering.
	May	Madison River	brown, rainbow trout	50-100	Reported too late to allow adequate investigation.
	May	Dry Creek (near Bozeman)	-	less than 20	Reported too late to allow adequate investigation.
	June	Divide Creek (near Divide)	brook trout	less than 50	Unverified; roadside herbicide suspected.
	July	Park Lake (near Clancy)	rainbow trout	50-100	Unverified; suspected problem with acclimation of stocked hatchery fish.
	July	Spring Creek West (near Kalispell)	brook trout	200-300	Irrigation dewatering.
	July	Bighorn River (near Fort Smith)	brown trout	1,000-2,000	Unverified; suspected aquatic herbicide.
	July	Tributary to Big Muddy Creek (near Greenfield)	brown, rainbow trout	less than 50	Acrolein applied to an irrigation ditch.
	July	Tongue River Reservoir (near Decker)	nongame only	-	Disease related.
	August	Flathead River (near Moiese)	nongame only	-	Disease related.
	August	Clark Fork River (near Warm Springs)	brown trout, whitefish	more than 10,000	Metals leached from mine tailings during a thunderstorm.
	August	Boulder River (near Basin)	whitefish	50	Metals leached from mine tailings during a thunderstorm.
	October	Musselshell River (near Ryegate)	nongame only	-	Breached sewage oxidation lagoon.
	November	Figgins Creek (near Bozeman)	brook trout	50	Reported too late to allow adequate investigation.

violation under the Pesticide Act. In the case of the latter, a negligent pesticide applicator may lose his license. Theoretically, threat of penalty or loss of livelihood should deter negligence. However, as with most laws, there are always some individuals who fail to act responsibly. These are the individuals we try to identify.

These laws are administered by the DHES and the DOA, respectively. Both agencies are routinely notified by the Department of Fish, Wildlife and Parks when fish kills happen, and both often participate in the investigation. On Indian reservations, the federal Environmental Protection Agency has jurisdiction over water quality instead of the DHES. This was the case on the Bighorn River fish kill which occurred on the Crow Indian Reservation. Although the Department of Fish, Wildlife and Parks has no regulatory authority during fish kill investigations, our involvement is essential because we are responsible for managing the fishery resource.

Q: How do you determine what caused a fish kill?

A: Several kinds of evidence may be gathered to try and verify causes of fish kills. These include: (1) analyses of water, sediment, and fish tissue samples; (2) evaluation of changes that may have occurred in the structure of fish tissues (tissue preparations are examined under a microscope); (3) observation of symptoms exhibited by dead or dying fish; (4) observation of activities that may have occurred near the upper reach of the kill; and (5) statements by those who might have some knowledge of what happened.

Q: What can you learn from a water sample?

A: Water samples are almost always collected during fish kill investigations; however, they seldom yield useful results. First, the process of the public observing and reporting a kill—combined with the travel time usually required for an investigation team to reach the site—allows the toxic material to move many miles downstream (provided the material is no longer entering the stream, which is usually the case). Even in a relatively slow-moving stream, the rate of flow is often two miles per hour. Furthermore, the agent can be dispersed, diluted by downstream water sources,

GLENN PHILLIPS

GLENN PHILLIPS

A leaking irrigation flume (above) crossing Racetrack Creek allowed the aquatic herbicide acrolein to enter the creek, killing over 250 brown trout. Gills of brown trout (below) from the Bighorn River below Yellowtail Dam show lesions characteristic of exposure to the aquatic herbicide acrolein.

absorbed onto the stream's substrate, or it can break down (if the compound is unstable). Acrolein, for example, breaks down so rapidly in sunlight that it cannot be detected unless analyzed within a few hours after it enters the water.

Finally, unless there are some clues about what we are looking for, the logistics of attempting to perform water analyses become overwhelming. There are literally thousands of chemicals used in Montana, many requiring special handling procedures and preservatives for analysis. Cost of analysis for any single compound ranges from a few dollars to more than $100 per sample. Simply, the Department of Fish, Wildlife and Parks cannot afford to routinely analyze for a long list of chemicals each time a fish kill occurs. More important, there is a good chance that the sample will have been taken too late to detect what caused the kill. Because of the above, the usual procedure is to collect and store water samples, but to perform analyses only if there are clues concerning the type of toxic agent responsible.

This is not to say that water samples should not be taken. Indeed, water samples can provide extremely valuable information, particularly if they can be collected at the onset of a kill. Citizens who observe a fish kill have the best opportunity to do this and are encouraged to collect a water sample if possible.

Q: Are the fish safe to eat?

A: It's small wonder the public is concerned about the safety of eating fish from a river after a fish kill—particularly in light of recent publicity concerning endrin, methylmercury, PCBs, etc. Fortunately, most chemicals, including many metals, do not accumulate appreciably in fish, particularly not in edible portions. Nevertheless, because there is always a chance that a persistent and dangerous chemical (such as methylmercury) may have caused a fish kill, the Department of Fish, Wildlife and Parks asks DHES to issue a precautionary warning that fish not be eaten until further notice. The general philosophy is that it is better to err on the safe side.

Like water samples, fish tissue samples are almost always collected and stored when a fish kill occurs. If the investigation reveals that the cause of the kill was not a persistent chemical, the samples are discarded. If there is reason to believe that a persistent chemical was responsible, edible tissues are analyzed for a spectrum of chlorinated hydrocarbons (DDT-like chemicals) and mercury (these are among the most likely to accumulate in the edible portions of fish). None of the fish kills investigated by the department over the last two years were caused by (or suspected of being caused by) a chemical that would endanger human health.

What Citizens Can Do

Citizens who happen to be streamside during a fish kill or shortly thereafter have an unusual opportunity to gather evidence before it disappears. If you are by a stream and notice dead fish or fish dying: (1) move upstream immediately and try to identify the cause; (2) if at all possible, take a water sample in a clean container and refrigerate as soon as possible; (3) collect dead or dying fish, wrap them in aluminum foil, and freeze them; (4) notify the Department of Fish, Wildlife and Parks (444-2406) as soon as possible. Prompt notification greatly improves the likelihood that the cause of a fish kill will be determined. Your action can be of immeasurable help to Montana's trout and other sport fishes. ■

Stevenson
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